# ALASKAN REGION

# AVIATION WEATHER SERVICES

# PLAN

August 23, 1999

VOLUME 2 of 2

This document was prepared with input from FAA sources, field facilities, National Weather Service, and Alaskan aviation user groups. The document will be updated yearly or as required to ensure up to date information and requirements.

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# Executive Summary

The FAA is moving into the future as evidenced by the National Airspace System (NAS) Architecture Plan, Free Flight Phase 1, the 2005 Concept of Operations, and a host of other programs. This document addresses the Alaskan Region's weather as it relates to the provision of Flight Services, Air Traffic Control and particularly the infrastructure used to gather and disseminate the weather observations needed to support the FAA mission. This document is broken into two volumes with Volume 1 providing a focal point, which compiles the present day requirements, current methods, projects in progress, problems identified and the future goals. Volume 2 will provide specific action items for planning the transition to the future.

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# 1 Introduction

## 1.1 Scope and Purpose

The Alaskan Aviation Weather Services Plan (AAWSP) is a compilation of requirements which describe the operational capabilities for the Alaskan Region today, and as envisioned in the National Airspace System (NAS) Plan for the future. It is intended for use as an internal FAA management tool to support the NAS and Regional specific programs, design, engineering, and acquisition activities. As such, this document expounds and expands upon the NAS System Requirements Specification by providing a local focus to manage and control change to the weather systems in Alaska.

## 1.2 Background

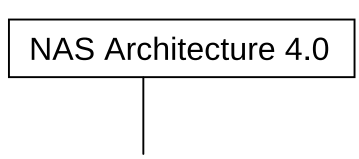
The FAA has established specific goals for modernization of the NAS over the next decade in a document called the NAS Plan. These include the replacement and modernization of weather sensors, dissemination networks and the products displayed.

In conjunction with the NAS Plan, the FAA has prepared system engineering management documents to assist in the orderly development and integration of NAS Plan programs, (See Paragraph 1.2.1 below). These documents lead to the establishment of projects, which are then funded and assigned a number in the Aviation System Capital Investment Plan (CIP). Not all NAS Plan programs are implemented in Alaska. This document will list the CIP weather projects and document the current program status in Alaska.

Just as there are NAS projects which are not implemented in Alaska, there are projects which are Alaskan unique but support the overall NAS Plan. This document lists these projects and provides a focus for the requirements they fulfill.

### 1.2.1 NAS Architecture Documentation

The Architecture Plan is not a specification but is a vision to follow while replacing aging equipment with new. It provides insight to the emerging technologies, which should be pursued, where applicable, in replacement of old systems. The NAS infrastructure projects supported are listed in the CIP. The CIP breaks down the major systems as follows; Automation, Communications, Facilities, Mission Support, Navigation and Landing, Surveillance and Weather. The process of NAS implementation is prescribed in the NAS Plan Documentation. Figure 1 below shows the order of NAS specifications.



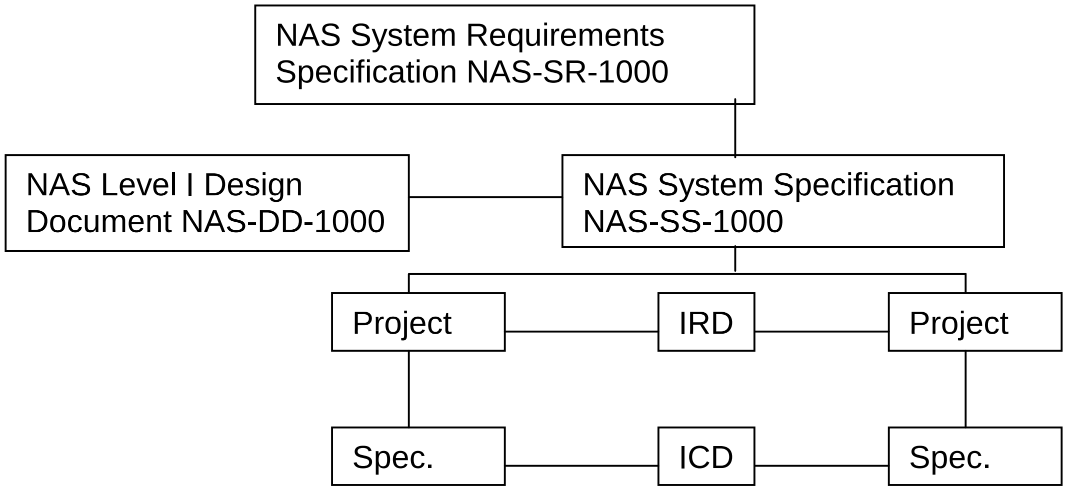



**Figure 1-1 Order of NAS Specifications**

The NAS-1000 Series of documents provide the meat to the bones of the NAS plan. The NAS-SR-1000 provides system service requirements for the NAS such as Paragraph 3.1.1.A.2; "The NAS shall acquire and maintain current surface aviation weather observations." It then goes on to list the eleven minimum items to be acquired. In the communications section of the NAS-SR-1000 it prescribes the time allowed to provide the service. The NAS-DD-1000 outlines the architecture of the NAS with diagrams describing the flow of information, see Figure 1-2. The NAS-SR-1000 and the NAS-DD-1000 work together to provide guidance for the NAS-SS-1000, which is a specific system and subsystem level specification for all NAS projects. Interface Requirement Documents (IRD) provide high level functional interface requirements between projects and Interface Control Documents (ICD) provide specific hardware and software specifications for interfaces between projects.

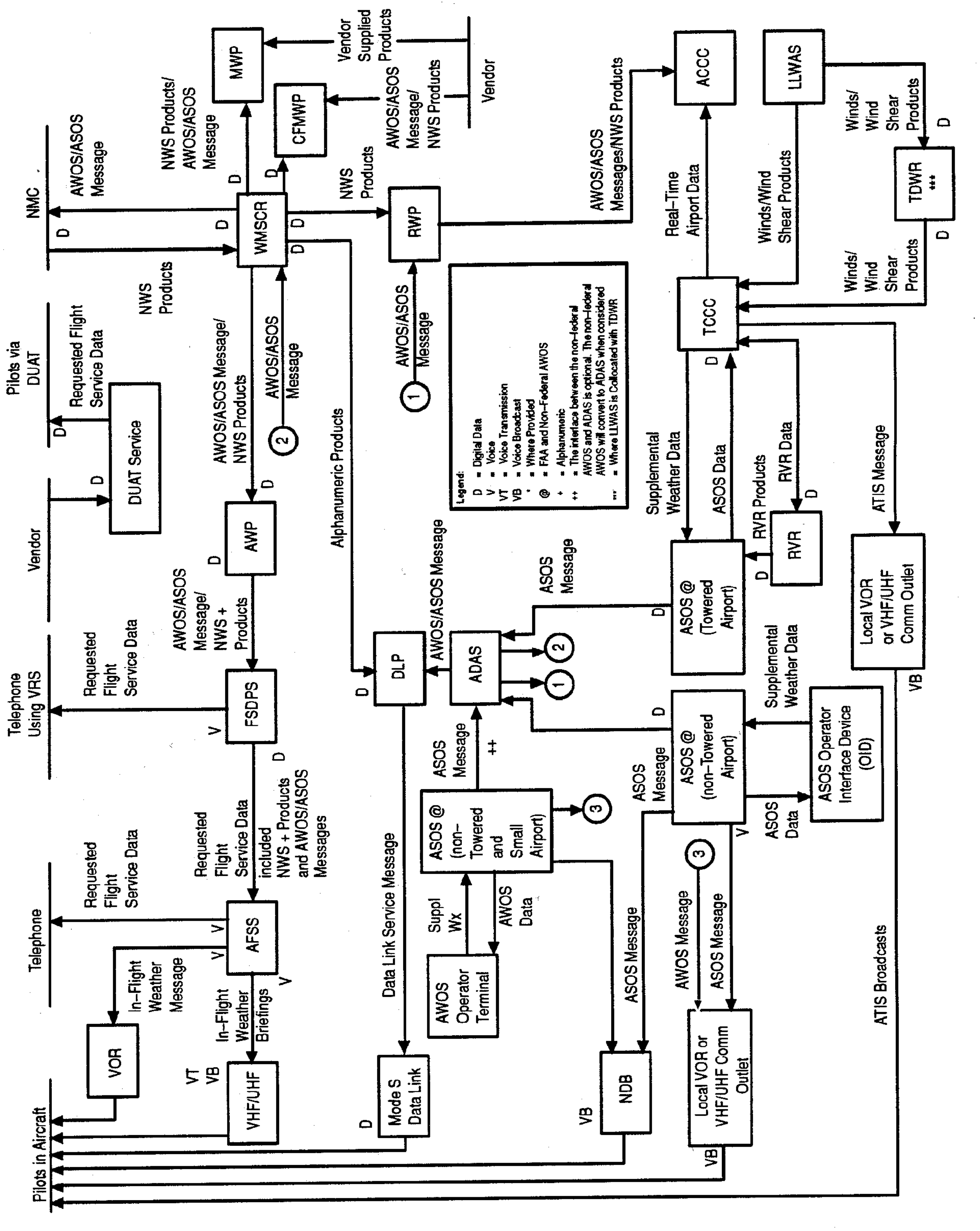



**Figure 1-2 Nonradar Weather Sensor Data Flow**

### 1.2.2 Alaskan Region Documentation

Within the Alaskan region, program management is defined in FAA Order 6000.19, “Alaska Region F&E Program Management Handbook.” Within this handbook are procedures for establishing projects based on the written requirements which are used to establish funding and provide guidance to the Project Coordination Team (PCT). An example of the written requirements is provided in Attachment 1 Digital Aviation Weather Network (DAWN).

## 1.3 Document Evolution

The AAWSP will be maintained to reflect changes as new capabilities are developed, existing systems are retired, and new needs are identified. Proposed changes to system requirements received by the FAA will be reviewed and analyzed to assess their potential costs and benefits. Based on these analyses, candidate requirements may be accepted, rejected, or returned for modification. Validated requirements, which cannot be implemented for funding, technical or other reasons are retained as unsatisfied requirements. The AAWSP will be revised and issued periodically as approved changes are adopted.

# 2 References

The FAA has begun automating National directives and placing them on the Internet for access. At this point, there is a limited number that have been posted. As offices create their home pages, more and more directives will become available. A link to the website has been made on the Alaska Region (AAL) WEB. If you cannot access the AALWEB or want to access the site directly, the address is, http://www.faa.gov .

## 2.1 NAS Publications

The NAS Architecture documentation can be found at www.faa.gov/asd/.
NAS Architecture Plan 4.0
NAS-SR-1000 NAS System Requirements Specification
NAS-DD-1000 NAS Design Document
NAS-SS-1000 NAS Systems Specification
Aviation System Capital Investment Plan (CIP) January 1997

## 2.2 FAA Orders

7000.2A Mar. 1977 FAA/NOAA Memorandum of Agreement
7032.15 Oct. 1994 Air Traffic Weather Needs and Requirements
6000.19 Sep. 1988 Alaska Region F&E Program Management Handbook

## 2.3 Interface Requirements and Control Documents (IRD) or (ICD)

ICD March 10, 1998 WIND/neX-REAP Client Server
ICD October 30, 1998 WARP/OASIS ICD
IRD May 8, 1998 NAS-IR-90029414 National Weather Service Telecommunications Gateway (NWSTG) to Federal Aviation Administration Bulk Weather Telecommunications Gateway (FBTWG)

# 3 NAS Weather Programs and Projects

This section will provide a brief description of the projects listed in the Capital Investment Plan (CIP) and provide status on the progress of the project in Alaska.

## 3.1 W-01 Automated Weather Observing Systems (AWOS/ASOS)

**Problem Statement:** The existing aviation weather observation network is not sufficient to provide a complete weather picture on a national/regional scale for both current and forecast information. The FAA requires the capability to provide weather information for terminal area forecasts and en route weather conditions. Flight safety depends on having accurate weather data.

The current system relies on increasingly expensive human weather observers and older, high maintenance weather sensors. The FAA needs to reduce these costs and increase service availability to ensure timely weather information is available to meet growing demands.

**Approach:** This project obtains aviation-critical weather data such as wind velocity, temperature, dew point, altimeter setting, cloud height, visibility, precipitation type, occurrence, and accumulation through the use of automated sensors. The automated systems will process the data and allow dissemination to pilots via computer generated voice. Weather data is also provided to the national weather network. This project includes an Automated Weather Observing System (AWOS) procured by the FAA and the Automated Surface Observing System (ASOS), a joint program with the National Weather Service (NWS), FAA and Department of Defense (DOD). AWOS and ASOS will be connected to the AWOS Data Acquisition System (ADAS). This system will collect and concentrate AWOS/ASOS weather messages from participating facilities and distribute the information via the Weather Message Switching Center Replacement (WMSCR) to the NWS.

**Current Status:**
The Regional Assistant Program Manager (RAPM) for this program is Vered Lovett, ANI-700. Her backup is Doug Lockwood, ANI-760.

Air Traffic and Flight Standards are the sponsoring divisions of a Fiscal Year (FY) 2000 project request for 39 ASOS installations. The table below lists the existing sites on the right side with a 1 for AWOS and a 2 for ASOS. The middle column lists the requested ASOS sites and the left column lists the initial CAPSTONE sites.

## EXISTING

### AWOS (1) & ASOS (2)

| | | |
|---|---|---|
| Ambler | AMF | 1 |
| Anaktuvuk | AKP | 1 |
| Anchorage | ANC | 2 |
| Anchorage | LHD | 2 |
| Anchorage | MRI | 2 |
| Aniak | ANI | 1 |
| Annette | ANN | 2 |
| Anvik | ANV | 1 |
| Arctic Village | ARC | 1 |
| Atka | 40A | 1 |
| Barrow | BRW | 2 |
| Bethel | BET | 2 |
| Bettles | BTT | 2 |
| Big Delta | BIG | 2 |
| Birchwood | BCV | 1 |
| Buckland | BVK | 1 |
| Chignik Bay | AJC | 1 |
| Cold Bay | CDB | 2 |
| Cordova | CDV | 2 |
| Deadhorse | SCC | 2 |
| Deering | DEE | 2 |
| Dillingham | DLG | 1 |
| Eagle | EAA | 2 |
| Egegik | EGD | 1 |
| Emmonak | ENM | 1 |
| Eureka | HNE | 1 |
| Fairbanks | FAI | 2 |
| Ft. Yukon | FYU | 1 |
| Gamble | GAM | 1 |
| Golovin | GLV | 1 |
| Gulkana | GKN | 2 |
| Gustavus | GST | 1 |
| Haines | HNS | 2 |
| Homer | HOM | 2 |
| Hooper Bay | HPB | 1 |
| Huslia | HSL | 1 |
| Hydaburg | HYG | 1 |
| Iliamna | ILI | 2 |
| Juneau | JNU | 2 |
| Kake | KAE | 1 |
| Kaltag | KAL | 2 |
| Kenai | ENA | 2 |
| Ketchikan | KTN | 2 |
| King Salmon | AKN | 2 |
| Kivalina | KVL | 2 |
| Klawock | AKW | 2 |
| Kodiak | ADQ | 2 |
| Kotzebue | OTZ | 2 |
| Koyuk | KKA | 1 |

## FY-2000 ASOS PROJECT REQUEST

| | |
|---|---|
| Akhiok | AKK |
| Allakaket | AET |
| Atka | 40A |
| Atqasuk | Z46 |
| Beaver Creek | WBQ |
| Chalkyitsik | CIK |
| Chevak | VAK |
| Coldfoot | CXF |
| Holy Cross | 4Z4 |
| Hoonah | HNH |
| Igiugig | IGG |
| Kalskag | KLG |
| Kiana | IAN |
| King Cove | KVC |
| Kipnuk | IIK |
| Kokhonak | 9K2 |
| Kwigillingok | AK8 |
| Manokotak | 17Z |
| Marshall | MLL |
| Mt. Village | MOU |
| Nelson Lagoon | Z73 |
| New Koliganek | KGK |
| New Stuyahok | KNW |
| Nikolai | 5NI |
| Nondalton | 5NN |
| Nulato | NUL |
| Perryville | AK0 |
| Pilot Point | PIP |
| Platinum | PTU |
| Ruby | RBY |
| Russian Mission | RSH |
| Scammon Bay | SCM |
| Shuyngnak | SHG |
| St. Michael | SMK |
| Teller | AK5 |
| Tok Junction | TKJ |
| Toksook Bay | OOK |
| Wales | IWK |
| Willow | Z22 |

## CAPSTONE INITIAL SITES

Holy Cross

Kalskag

Kipnuk

Koliganek

Kwigillingok

Mt. Village

Platinum

Russian Mission

Scammon Bay

St. Michael

## EXISTING

### AWOS (1) & ASOS (2) (Continued)

| | | |
|---|---|---|
| McGrath | MCG | 2 |
| McKinley Park | 5MK | 1 |

| | | |
|---|---|---|
| Mekoryuk | MY | **1** |
| Metlakatla | MTM | **1** |
| Middleton Is. | MDO | **1** |
| Minchumina | MHM | **1** |
| Nenana | ENN | **2** |
| Noatak | WTK | **1** |
| Nome | OME | **2** |
| Northway | ORT | **2** |
| Nuiqsut | 10AK | **2** |
| Palmer | PAQ | **2** |
| Petersburg | PSG | **1** |
| Port Heiden | PTH | **1** |
| Portage | A21 | **2** |
| Pt. Hope | PHO | **1** |
| Sand Pt. | SDP | **1** |
| Savoonga | SVA | **1** |
| Selawik | WLK | **1** |
| Seldovia | SOV | **2** |
| Seward | SWD | **2** |
| Shishmaref | SHH | **1** |
| Sitka | SIT | **2** |
| Skagway | SGY | **2** |
| Sleetmute | SLQ | **1** |
| Soldotna | SXQ | **1** |
| St. George | A8L | **2** |
| St. Marys | KSM | **1** |
| St Paul Is. | SNP | **2** |
| Talkeetna | TKA | **2** |
| Tanana | TAL | **2** |
| Togiak | TOG | **1** |
| Unalakleet | UNK | **1** |
| Unalaska | DUT | **1** |
| Valdez | VDZ | **1** |
| Wainwright | AWI | **2** |
| Wasilla | IYS | **1** |
| Wrangell | WRG | **1** |
| Yakutat | YAK | **2** |

The requested ASOS sites overlap the existing AWOS site at Atka and cover all but one Capstone site. For additional information on the existing sites see Volume 1, Appendix 1 of this document. For more information on Capstone, see paragraph 4.6.

## 3.2 W-02 Weather Radar Program (NEXRAD)

**Problem Statement:** Weather presentations available from en route radar systems provide limited data for air traffic control. The Next Generation Weather Radar (NEXRAD) project installed a weather radar network that provides greatly enhanced weather detection capabilities that improves overall aviation safety. NEXRAD is very sensitive and under certain meteorological conditions will inadvertently detect false echoes known as anomalous propagation. This anomaly needs to be addressed prior to displaying NEXRAD data on controller's consoles. Adjusting for this anomaly and other format requirements of the raw data from NEXRAD for display on the controller's consoles is the job of the Weather and Radar Processor (WARP). In Alaska, the NWS formats the NEXRAD data into a graphical image for transmission to the AFSS via the Alaskan Aviation Weather Briefing System (AAWBS).

**Approach:** NEXRAD is being funded jointly by the NWS, the DoD, and the FAA. The project is managed by a tri-agency program management counsel under the National Oceanic and Atmospheric Administration. The FAA pays 20 percent of cost for 126 NWS network locations and 100 percent of the cost for 12 FAA offshore sites (seven in Alaska, four in Hawaii, and one in Puerto Rico). The remote locations where these FAA systems are installed require modifications, such as power conditioning systems; (lightning grounding, bonding, shielding), and remote maintenance monitoring modules unique to the FAA. An Operational Support Facility (OSF) has been established in Norman, Oklahoma to provide such services as software maintenance, field problem resolution, configuration management, and technical manual maintenance. This organization is responsible for system modification, enhancements, and product improvements. This project will develop software algorithms to alleviate anomalous propagation problems. Other algorithms will be developed and installed to better detect aviation weather hazards. These enhancements will improve the effectiveness of NEXRAD data for aviation use. This project will upgrade the NEXRAD to an open system architecture to efficiently integrate new software algorithms.

**Current Status:** The RAPM for the NEXRAD program is Vered Lovett, ANI-700.

Planning efforts center on establishing a forum with the other users of the system for maintenance issues. The FAA is the sole owner and maintainer of the Alaska NEXRAD system. This means the FAA is involved in the trouble shooting of communications problems for other users. Each of the agencies and a limited number of certified vendors are allotted a private line connection to the NEXRAD. In the case of the FAA this line is specified for a data quality based on standard telecommunications practices. These standards insure a quality copper line connection to the nearest Alaskan NAS Interfacility Communications System (ANICS), which forwards the products to the Weather and Radar Processor (WARP). That is the connectivity for the FAA not for the rest of the users. They order their connectivity through telecommunication vendors. Though the connection is the responsibility of the user, the NEXRAD communications equipment is the responsibility of the FAA. Therefore, it is important to develop a means of remotely monitoring these lines for problem resolution with various vendors.

The Open System Infrastructure (OSI) was put into planning by the OSF early in 1999. Status for OSI is unknown at this time.

Alaska has received seven NEXRAD systems. For more information on the existing systems see Volume 1 of this document.

## 3.3 W-03 Terminal Doppler Weather Radar (TDWR) System

**Problem Statement:** Windshear has been the cause of a number of aviation accidents. Windshear is an abrupt change in wind direction and/or velocity that may occur in clear air or in areas of precipitation. The most dangerous form of windshear are microbursts that are particularly dangerous to aircraft landing or departing. Wind shifts and potentially hazardous weather are also major cause of delays at airports.

**Approach:** This project will procure and install TDWR systems that detect microburst, gust fronts, wind shifts and precipitation. These radar systems are used to alert aircraft in the terminal area of hazardous weather conditions and provide advanced notice of changing wind conditions permitting timely change of active runways.

**Current Status:** There are no plans to install TDWR systems in the Alaskan Region. For a comprehensive explanation of why this project is not being employed in Alaska, see paragraph 3.9 below.

## 3.4 W-04 Weather and Radar Processor (WARP)

**Problem Statement:** Currently the weather information provided to the air traffic controllers in the en route environment comes from the long range surveillance radars which are not well suited for this purpose. NEXRAD will replace the surveillance radars as the source for weather information; however, this information cannot be displayed on existing en route controllers' consoles due to digital versus analog and other compatibility issues. Additionally, the Center

Weather Service Unit (CWSU) meteorologists do not have an integrated system for collecting and displaying multiple weather sensor inputs.  The current system relies on human interpretation to integrate available information which is time consuming and inefficient.

**Approach:** The WARP system will collect, process and disseminate NEXRAD and other weather information to controllers, traffic management specialists, area supervisors, pilots, and meteorologists.  WARP will provide a mosaic of multiple NEXRAD images to the Display System Replacement (DSR) for display with aircraft targets.  This will improve the quality of weather information available to air traffic controllers, thereby, reducing accidents and air traffic delays.  WARP will also provide the CWSU meteorologists with automated workstations, which greatly enhance their ability to analyze rapidly changing and potentially hazardous weather conditions.  WARP will ensure that the latest and best information is provided to all system users within the en route environment.  This project well be completed in three stages.

**Stage 0** provides the commercial off-the-shelf and non-developmental item portions of WARP hardware and software as a leased, turn-key system that will replace the existing meteorologist weather processor with updated technology.

**Stage 1 & 2** develops the NAS interfaces necessary to provide NEXRAD data to controllers' consoles via the DSR project.  This stage will use commercial off-the-shelf components to upgrade Stage 0 hardware.  Stage 1 & 2 will also provide meteorologists with additional data and analysis tools in a single integrated workstation replacing the NEXRAD principal user processor.  This effort is being conducted in parallel with Stage 0 and will take approximately two years to fully develop, test and implement.

**Stage 3** develops additional NAS interfaces for cost effective weather data sharing and facilitates a common situational awareness within the en route environment.  It implements upgraded NWS gridded data and leverages the FAA's investment in aviation weather research with sensor and algorithm upgrades to the WARP system.  It also provides a common source for distributing NWS high volume models and enhanced weather displays for controllers on the DSR.

**Current Status:** Bruce Benson, ANI-740 is the RAPM for the WARP system.

Since the 1997 publication of the CIP program approach above there has been a submittal of an IRD for WARP to disseminate weather to the Operational and Supportability Implementation System (OASIS).  The OASIS project is described below in paragraph 3.4.1.  In addition to OASIS, WARP disseminates weather products to the DSR and CWSU as stated above.  WARP collects weather data from NEXRAD, NWS and WMSCR.  There are three separate issues involving dissemination of WARP products.

**Issue 1:** The above is true in all cases except Alaska, Hawaii, San Juan Puerto Rico and Guam. The major difference between these sites and the contiguous states is the Micro En Route Automated Radar Tracking System (MEARTS) versus HOST[1] computer, which drives the DSR air traffic control console. In addition, of these sites only Alaska has WARP for collection of NEXRAD data.
**Current Action:** In light of this situation, there is a case file before AUA-600 division to modify the MEART software to ingest NEXRAD data and display it at the air traffic control console in accordance with the product descriptions and displays documented in the WARP/DSR ICD. The case file specifies the functional requirement for raw NEXRAD data from each NEXRAD site within the area of concern. It does not specify the physical interface for NEXRAD data because the collection of NEXRAD data at non-WARP sites may vary.
**Required Action:** In Alaska, a contract change to the WARP would allow the nationally defined NEXRAD products, which WARP obtains from the NEXRAD to be forwarded, in the same file format as received from the NEXRAD, to the MEARTS gateway at Anchorage Center.

**Issue 2:** The WARP/OASIS ICD was reviewed and commented on by the Alaskan Region in the last part of February 1999.
**Current Action:** The concerns brought forward are that the WARP was not collecting the Alaska Aviation Weather Unit (AAWU) forecast products for dissemination to OASIS, which provides products to the Automated Flight Service Station (AFSS). The products in question are provided today to the flight service specialist via the Alaskan Aviation Weather Briefing System (AAWBS) see paragraph 4.4 below. The products desired from the NWS AAWU were listed in the same format as WARP/OASIS ICD Table 3.2.4 and forwarded to ATO-420.
**Required Action:** A contract change to the WARP will provide a Directory for the WARP server to store the AAWU products. There would be no change to the physical connectivity. The new products will use the same path used to provide the NWS products i.e. Polar Satellite and Lightning Data. Also, a letter to the Alaskan NWS requesting AAWU products be added to the WARP TCP/IP address.

**Issue 3:** The third issue concerns the NWS forecasting personnel at the CWSU, who have defined a need for the Advanced Weather Information Processing System (AWIPS). In Volume 1 of this document we discussed the CWSU and its connectivity to the NWS via the Aeronautical Weather Network (AERONET). The AWIPS is a national program, which replaces various regional projects with a nationally base lined system. The WARP office believes that the WARP stage1 & 2 capability to access the NEXRAD with Class 1 ports and the stage 3 gridded data provided to WARP via the FAA Bulk Weather Telecommunications

[1] HOST is not an acronym but the name of the program taken from the fact that the computer "hosts" the enroute automated tracking system.

Gateway (FBWTG) will provide all the functionality needed by the CWSU. For more information on the FBWTG see the NAS Architecture Plan 4.0 chapter 26.
**Current Action:** The Alaskan NWS has provided a white paper which details the differences between the WARP products and the AWIPS processor (See Attachment 2), which has been forwarded to ATO-420. The attachment contains the original memo, an updated version with comments received from the WARP program office, and the response from the originating NWS author.
**Required Action:** In July of 1999, Daphne Jefferson, ATO-310, and members of the WARP program office met with NWS headquarters to discuss AWIPS requirements at the CWSU. Several options were presented by the NWS and the group is expected to continue monthly meetings until the issue is resolved.

### 3.4.1 A-07 Operational and Supportability Implementation System (OASIS)

**Problem Statement:** General aviation comprises over 95 percent of all flights within the U.S. These customers depend on the fight information services such as weather and flight planning. The flight service automation system provides a flight service specialist with textual weather, Notice to Airmen (NOTAM) briefings, and simplifies flight plan filing. The existing automation system infrastructure is 15 years old and has reached the end of its economic service life. Additionally, this system cannot be expanded or enhanced to accommodate current and future functional requirements.

**Approach:** OASIS will replace the Flight Services Automation System (FSAS) Model I full capacity (M1FC). This will enhance the current flight service automation system. OASIS will incorporate a uniform graphic weather display system capability at automated flight service stations. OASIS will be an integrated alphanumeric and weather graphic solution that maximizes the use of commercial-off-the-shelf hardware and software. OASIS will integrate the functionalities of the M1FC, graphic weather display and the Direct User Access Terminal (DUAT) into a single national system. This new infrastructure will support future concepts such as free flight, automatic dependent surveillance, automated special use airspace updates and in-flight aircraft situation capabilities through preplanned product improvements.

The following statement is an excerpt from the 1999 CIP and describes the means of obtaining weather products for the OASIS.

The OASIS initial operating capability will import weather graphic products from commercial sources to provide graphic weather display functionality and replace the existing interim system. OASIS will be modified through preplanned product improvements to import weather graphic products from WARP project.

In the Alaskan Region the AAWBS has provided NWS products to the flight services specialist for the past 2 years. This system is a precursor to OASIS and the products provided have been planned and approved. Therefore, as stated in

Issue 2 above, the WARP/OASIS ICD describes the weather products to be obtained by WARP for dissemination to OASIS has been reviewed by this region and the AAWBS products were defined as a requirement for OASIS.

**Current Status:** The OASIS RAPM is Mel Leskinen, ANI-740.

Current actions taken on OASIS are as described above in WARP Issue 2.

## 3.5 W-05 Low-Level Windshear Alert System (LLWAS)

**Problem Statement:** The LLWAS provides local controllers with information on microbursts and windshears on or near airports that will not receive terminal Doppler weather radars or airport surveillance radar weather system processors. The existing LLWAS hardware and software is between 15 and 20 years old and is becoming difficult to support.

**Approach:** This project consists of the following three efforts:

1. The LLWAS network expansion is upgrading nine airports to provide increased probability of microburst and windshear detection by improving the detection algorithms and increasing the number of sensors.
2. The LLWAS life extension and refurbishment project will sustain 52 sites. These systems will be refurbished to become logistically supportable for at least 15 years.
3. This project will also relocate sensors at selected airports to restore LLWAS detection effectiveness. The entire LLWAS network will be surveyed to determine which airports require sensor relocation and where the sensors should be installed.

**Current Status:** There are no existing installations or plans to install LLWAS in the Alaskan region. For a see paragraph 3.9 below.

## 3.6 W-06 Digital Altimeter Setting Indicator (DASI) Replacement

**Problem Statement:** A digital altimeter setting indicator provides a digital readout of barometric pressure/altimeter setting at airport traffic control tower/terminal radar approach control locations. The barometric pressure/altimeter setting number serves as a reference against which aircraft altimeters can be adjusted for atmospheric pressure variations. Periodic up dating of altimeter setting while en route enables pilots to maintain the correct vertical separation between aircraft and ground obstructions. Some of these indicators have been in service since 1976, and are impossible to maintain. Parts are no longer available because the vendors do not manufacture the obsolete technology used in these older systems.

**Approach:** This project originally replaced 175 obsolete Sperry, Airflo, and Belfort digital altimeter setting indicators at airport traffic control towers. The DASI project will be expanded to replace an additional 300 systems manufactured by C & G Corporation. The replacement systems use modern microprocessor technology to improve reliability and maintainability. The new DASI systems are commercially available products that meet FAA specifications. When this project is completed all FAA DASI systems will be from a single manufacturer which greatly simplifies logistics support, maintenance, and training.

**Current Status:** The RAPM for this program is Vered Lovett, ANI-700.

### 3.7 W-07 Integrated Terminal Weather System (ITWS)

**Problem Statement:** Weather is responsible for approximately two thirds of delays in the NAS with large impacts at major hub airports. The FAA does not have the capability to provide highly accurate characterizations and predictions of weather impacting terminal areas. Without highly accurate weather predictions and a common method to distribute the information, air traffic management cannot make the most efficient use of available terminal airspace resources. Current weather sensors can detect hazardous weather conditions in the terminal area that enable aircraft to react to these conditions. However, to improve safety margins, the FAA needs a near-term predictive capability to ensure aircraft avoid these conditions before they occur.

**Approach:** This project will integrate all relevant weather data available in the terminal area, including data down linked from aircraft, to automatically provide near-term weather information and predictions. This information will be presented in easily understood graphical and textural form for air traffic personnel and pilots. ITWS provides safety and planning products to terminal aviation system users. These products characterize the current terminal weather situation and forecast approximately 30 minutes into the future. ITWS products are generated by integrating data from various FAA and NWS sensors such as TDWR, NEXRAD, LLWAS, AWOS, and ASR-9. Other data is collected from aircraft via the meteorological data collection and reporting system, and NWS weather models. Products generated by ITWS include windshear and microburst predictions, storm cell and lightning information, terminal area winds aloft, runway winds, and short-term ceiling and visibility predictions. Prototype systems have been installed at three locations to demonstrate the effectiveness of these products in an operational environment.
**Current Status:** There are no plans to install ITWS in the Alaskan Region. For a comprehensive explanation see paragraph 3.9 below.

### 3.8 W-09 Airport Surveillance Radar (ASR) Weather Systems

**Problem Statement:** The FAA needs hazardous weather detection capabilities in the terminal environment to increase safety and airport capacity. Windshear in the terminal environment has been the cause of a number of aviation accidents. Windshear is an abrupt change in wind direction and/or velocity that may occur in clear air or in areas of precipitation. The most dangerous form of windshear are microbursts that are particularly dangerous to aircraft landing or departing.  Wind shifts and potentially hazardous weather are also major causes of delays at airports.  However, it is not cost effective to install terminal Doppler weather radar at medium to small terminal facilities.

**Approach:** This project was initiated in response to National Transportation Safety Board (NTSB) Recommendation A-90-84.  This project enhances the hazardous weather detection capability of ASR-9 at airports that do not qualify for terminal Doppler weather radar.  Enhancements are accomplished by developing a modular data processing channel for automatic detection of hazardous weather including thunderstorms, windshears, microburst, and gust fronts.   Lincoln Laboratory developed and demonstrated radar modification, data processing computers, and processing algorithms that enable an ASR-9 to detect low-altitude windshears, microburst, and gust fronts.  Techniques have been implemented on a production radar and demonstrated during tests at the Kansas City, MO, Orlando, FL, and Albuquerque, NM airports.

**Current Status:** There are no plans to install ASR-9 in the Alaskan region.

Instead, Anchorage and Fairbanks TRACONs will each receive the most recent version radar, ASR-11.  Anchorage is scheduled for operation by the end of 2001 and Fairbanks by the middle of 2002.   Neither TRACON has been selected for the ITWS program but each will benefit from the inherent weather detection and display capabilities of the ASR-11 for their area of control.

The RAPM for this program is Vered Lovett, ANI-700.

## 3.9 NAS Weather Programs and Projects Summary

Of the CIP projects listed above six are sensors and three (including OASIS) are collection/distribution systems.  This is shown in Figure 3-1  Sensors and Collection/Dissemination below.

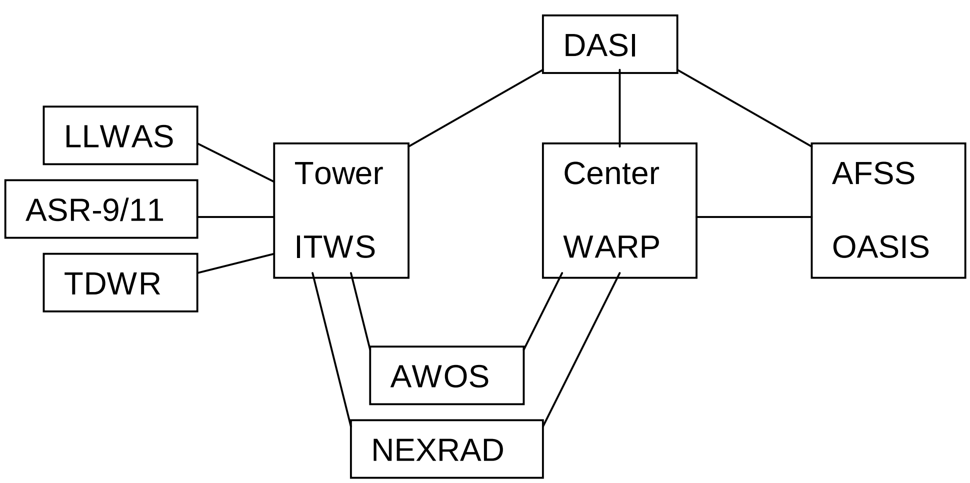



**Figure 3-1  Sensors and Collection/Dissemination Network**

The major difference between the ITWS for the tower and the en route WARP/OASIS systems is ITWS will use many sensors in a relatively small area to perform predictions into the future and display text or graphics as required. While WARP and OASIS will collect/disseminate and display text or graphical data but they do not contain algorithms for weather forecasting.

The reason Alaska is not scheduled for ITWS, LLWAS and TDWR is that these systems were targeted for high-density traffic areas to support ITWS. In addition, the ITWS algorithms are designed for the central portion of the U.S. where the terrain is flat and the heated landmass convection causes the thunderstorms and tornadoes typical to that portion of the country. The coastal regions experience mechanical windshear due to rugged terrain, which requires different algorithms for prediction. This is why Alaska has a congressional mandate to do the Juneau Wind Profiler project (see paragraph 4.3 below).

# 4 AAL Programs and Projects

Alaska has regional projects with national oversight to address both developing technologies for NAS modernization and specific regional projects to provide services in a region with unique geographic and communication structures.

## 4.1 En Route Flight Advisory Service (EFAS)

**Problem Statement:** The Air Traffic Flight Services personnel have requested the ability to provide the service as a part of standardization with the contiguous 48 states.

**Approach:** The Alaskan Region Air Traffic Division, AAL-500, is in the process of reviewing the current radio coverage, frequency availability and user benefits for determining the cost versus benefit of providing the service.

**Current Status:** There is no project in place for EFAS in Alaska. The focal point for coordination of requirements is Kimo Villar, AAL-530.

## 4.2 Weather Cameras (Cams)

**Problem Statement:** In 1995, the NTSB conducted a study of aviation safety in Alaska. It made the following safety recommendation to the FAA with respect to aviation weather reporting:

Assist the NWS with an evaluation of the technical feasibility and aviation safety benefits of remote color video weather observing systems in Alaska. (A-95-128)

In addition, Attachment 4, Weather Services in the Lynn Canal, is the Juneau Flight Standards study on the feasibility of obtaining additional weather reporting capability between Juneau and Skagway, Alaska, with additional commentary on greater Southeast Alaska. The topic of weather cameras was discussed extensively in this study and is generally considered the beginning of the weather cams project.

**Approach:** This project has two distinct phases. The first phase is to provide Internet service directly to the flying public. The second phase consists of providing secure communications infrastructure to the AFSS/FSS and development of equipment certification and operational procedures.

**Current Status:** The Weather Cams Program Manager (PM) is Doug Lockwood ANI-760. ANI-760 has purchased video cameras and is in the process of testing at this time. Testing of the system can be seen online at **www.akweathercams.com**. This FAA site is linked to an Alaska University grad-students project, which also has camera sites at various airports in Alaska. ANI-760 has produced a Generic Site Implementation Plan (GSIP) and it is under review at this time.

## 4.3 Juneau Wind Profiler

**Problem Statement:** Flight Standards imposed restrictions on departures from the Juneau airport, which primarily affected Alaska Airlines. Alaska Airlines began a program to provide wind data in several key areas affected by the restrictions. In addition, the equipment utilized by Alaska Airlines was incorporated in an R&D project by the National Center for Atmospheric Research (NCAR). The R&D project includes wind profilers, anemometers and computers for storage and display of data collected. The FAA has assumed ownership of the Alaska Airlines anemometers and continues to support NCAR development of prediction tools.

**Approach:** The Juneau Wind Profiler project has two phases. The first is to establish procedures for use of the equipment in relaying winds as requested. The second is in support of the R&D project for development of windshear predictions in rough terrain.

**Current Status:** The Juneau Wind Profiler Project Manager is Richard Girard of AAL-203. The Wind Profiler displayed data can be seen at **www.rap.ucar.edu/staff/pneilley/juneau/profilers.html**. ARW-400 met with the Alaskan Region on April 20 through 22, 1999, to discuss this project. Attachment 5 are the minutes from this meeting.

## 4.4 Alaskan Aviation Weather Briefing System (AAWBS)

**Problem Statement:** The Alaskan Region NWS distributes unique graphical products for the Region. The implementation of the Alaskan NAS Interfacility Communications System (ANICS) provided a simple and cost effective means of providing these products to the AFSS and when DAWN is complete it will replace the dialup connectivity used by the FSS today. The equipment provided with AAWBS allowed the replacement of the outdated/ unsupportable proprietary Kavorous at the AFSSs and Digital Facsimile (DIFAX) at the FSSs. The AAWBS can be viewed as the precursor to the OASIS.

**Approach:** The AAWBS is an operational system but has the ability to be modified with products as required by the FAA and provided by the NWS. Changes in product requirements are formalized via a Memorandum of Understanding (MOU) with the NWS.

**Current Status:** The focal point for coordination of requirements is Kimo Villar AAL-530.
Currently the region has identified six NEXRAD products as changes to the AAWBS to be provided to the flight service specialists. The products requested are identified in a letter to the NWS, Attachment 3. There have been some problems recently identified with the shift from the NWS regional AERONET to

the NWS national AWIPS program. The AWIPS does not support some of the program functions provided by the AERONET making conversion of the NEXRAD products into graphical images for transmission via the AAWBS difficult. The NWS is working on it.

### 4.5 Digital Aviation Weather Network (DAWN)

**Problem Statement:** The existing weather (Service A) and flight information (Service B) are distributed via the DAWN, which replaced the GS-200 equipment supplied by General Telephone and Electric (GTE) under the Leased A/B Service (LABS) contract. The LABS equipment was not Y2K compliant. In addition, the GS-200 is a 15-year-old technology and increasingly difficult to service.

**Approach:** Phase I of this project is focused on a one-for-one replacement for current GS-200 and LABS functionality. However, future enhancements are already planned and new requirements will be incorporated in future improvements. Service A will be implemented through a browser interface. Service B is initially planned to be accomplished through the use of the "Micronesia" application developed by the Tech Center. The Micronesia code was used by the Region as a starting point,, and a new code written and compiled using Borland C++ version 5.02, which runs in Windows NT, is in use. This program has been funded through AOP-400 based on projected savings from shutting off the LABS/ GS-200 leased service.

**Current Status:** The DAWN Program Manager is Larry Ihlen, AAL-470LI. Phase I of the DAWN was completed on June 15, 1999.

### 4.6 Capstone

**Problem Statement:** Under the national "Safe Flight 21 Program," some Capstone-equipped aircraft and the Capstone ground system infrastructure will be used to validate three of the nine high priority Free Flight Operational Enhancements requested by the Radio Telecommunications Conference of America (RTCA). RTCA, a FAA Advisory Committee, recommended the nine enhancements in its "Joint Government/ Industry Roadmap for Free Flight Operational Enhancements." The three enhancements to begin validation in Alaska in FY 1999 are:

- Flight Information System (FIS)
- Cost Effective Controlled Flight Into Terrain (CFIT) Avoidance
- Enhanced See and Avoid

FIS - Weather Products, Special Use Airspace, Wind Shear Alerts, NOTAMs, and PIREPs.

Of these three enhancements the FIS services are similar to the Direct Users Access Terminal (DUAT) services. The major difference is in the use of radio data link between the aircraft and data server.

**Approach:** The Capstone Program will arrange for government or commercial service FIS products to be delivered to the pilot's multi-function display via a data link communications system. The products will include text messages, advanced weather maps, notices concerning the activation or other status of special use airspace, wind shear and other significant weather alerts, NOTAMs and pilot reports (PIREPs).
FIS data will be transmitted to each Capstone server via existing telephone or ANICS. The Internet may be used to facilitate the flow of information between an aircraft pilot and his/her dispatch office. Services may either originate within the Anchorage Air Route Traffic Control Center (ARTCC) or be procured from a commercial vendor. The Capstone server will use data link technology to broadcast information to Capstone-equipped aircraft within its service area. The same data link may be used for both Automatic Dependent Surveillance Broadcast (ADS-B) and FIS, or another separate data link technology may be used. It is the program's intent to use the national standard FIS service data if it is available in Alaska during Capstone.

Global Positioning System (GPS) non-precision instrument approach procedures will be prepared and published for one or more runways at each of ten remote village airports within the Capstone test area. The Capstone Industry Council and the Alaska Department of Transportation and Public Facilities (DOTPF) jointly selected these high priority airports.

An FAA-certified automated weather observation system with radio broadcast capability (AWOS III) will be installed under the Capstone Program at the ten remote village airports to enable air carrier use of the new non-precision GPS instrument approach procedures.

**Current Status:** The Capstone Program Manager is John Hallinan, AAL-001SC. This program office released a Request for Proposal in March of 1999, to attain the radio equipment for the project. Notification was given by the program office on June 2, that United Postal Service (UPS) Aviation Technologies (formerly II Morrow, Inc) was chosen as the company down selected to demonstrate avionics and ground station equipment this summer in Bethel. The purchase and installation of the AWOS at the ten Capstone sites is being done by ANI-760, Doug Lockwood.

## 4.7 Flight Information Service Data Link (FISDL)

**Problem Statement:** Flight Information Services (FIS) are defined as the noncontrol, advisory information needed by pilots to operate more safely and efficiently in the NAS and in international airspace. Flight information services include information necessary for continued safe flight and for flight planning, whether in the air or on the ground. The FAA's goal for FIS in the cockpit is to use digital data link to deliver information to the pilot, and in doing so, improve safety, reduce costs to users and the FAA, and increase the utility, efficiency, and capacity of the NAS.  The timely provision of high quality, accurate, and consistent information is essential to support sound operational decisions by pilots, controllers, and dispatchers.

**Approach:** Initial FIS products for delivery to the cockpit include information on the status of the NAS NOTAMs and meteorological information, both in textual as well as graphical format.  This policy supports the inherent efficiency of providing certain FIS through automated data communications to complement, not replace, existing voice communications.

The FAA's objective is to ensure product and infrastructure development and provision of services for sending FIS to aircraft via data link. In the constrained Federal budget environment under which the FAA is operating, this new service is dependent on a public/private partnership to provide affordable FIS products. The FAA will utilize private sector's FIS capabilities to the maximum extent possible to bring FIS services and products to the marketplace quickly and efficiently.  Therefore, future FIS services may be multi-tiered, with certain services and products being provided by the Government and others by the private sector.  The FAA will seek a mix of private and public services to provide the most reasonable combination of cost and efficiency to the users.

**Current Status:** The following is an excerpt from a FAA press release in July of 1999.

The FAA, NavRadio Corp. of Golden, Colo; and ARNAV Systems, Inc. of Puyallup, Wash., have teamed to enable the general aviation community to obtain Flight Information services via Data Link.  Initial operating capability is planned within six months with Alaska as the first site.

While this is a separate Data Link from the Capstone Data Link.  There are plans within the Capstone program office to obtain FIS products for redistribution within the Capstone arena.

# Appendix A Acronyms

| | |
|---|---|
| AAWBS | Alaskan Aviation Weather Briefing System |
| AAWU | Alaskan Aviation Weather Unit |
| ADAS | Automatic Data Acquisition System |
| ADS-B | Automatic Dependent Surveillance Broadcast |
| AFOS | Automated Field Operations Services |
| AFSS | Automated Flight Service Station |
| AF | Airway Facilities |
| AMS | Acquisition Management System |
| ANICS | Alaskan NAS Interfacility Communications System |
| ANSI | American National Standards Institute |
| AERONET | Aeronautical Weather Network |
| ARS-9 | Airport Surveillance Radar Model 9 |
| ARTCC | Air Route Traffic Control Center |
| ASOS | Automated Surface Observation System |
| AT | Air Traffic |
| ATS | Air Traffic Service |
| AWIPS | Advanced Weather Information Processing System |
| AWOS | Automated Weather Observation System |
| BT | Briefing Terminal |
| CFIT | Controlled Flight Into Terrain |
| COI | Critical Operational Issue |
| CWSU | Center Weather Service Unit |
| DASI | Digital Altimeter Setting Indicator |
| DAWN | Digital Aviation Weather Network |
| DIFAX | Digital Facsimile |
| DUAT | Direct User Access Terminal |
| DOT | Department of Transportation |
| DOTPF | Department of Transportation Public Facilities |
| ECP | Engineering Change Proposal |
| EFAS | En Route Flight Advisory Service |
| FBWTG | FAA Bulk Weather Telecommunications Gateway |
| FAA | Federal Aviation Administration |
| FIS | Flight Information Services |
| FISDL | Flight Information Services Data Link |
| FSAS | Flight Services Automation System |
| GIF | Graphics Interface Format |
| GPS | Global Positioning System |
| GSIP | Generic Site Implementation Plan |
| IPT | Integrated Product Team |
| ITWS | Integrated Terminal Weather System |
| JPG | JPEG Joint Photographic Experts Group |
| LABS | Least A/B Service |
| MEARTS | Micro En Route Automated Radar Tracking System |
| MOU | Memorandum of Understanding |

| | |
|---|---|
| MSL | Mean Sea Level |
| M1FC | Model 1 Full Capacity |
| NAS | National Airspace System |
| NCAR | National Center for Atmospheric Research |
| NEXRAD | Next Generation Weather Radar |
| NCP | NAS Change Proposal |
| NOTAM | Notice to Airmen |
| NTSB | National Transportation Safety Board |
| NWS | National Weather Service |
| NWSTG | National Weather Service Telecommunications Gateway |
| N/A | not applicable |
| OASIS | Operational and Supportability Implementation System |
| OSF | Operational Support Facility |
| OSI | Open Systems Infrastructure |
| $P^3I$ | Pre-Planned Product Improvement |
| PC | Personal Computer |
| PIP | Program Implementation Plan |
| PIREP | Pilot Report |
| RAPM | Regional Assistant Program Manager |
| RTA | Remote Terminal to AFOS |
| TIF | TIFF Tag Image File Format |
| TDWR | Terminal Doppler Weather Radar |
| UPS | United Postal Service |
| WARP | Weather And Radar Processor |
| WMSCR | Weather Message Switching Center Replacement |
| WSFO | Weather Service Forecast Offices |

# Operations Requirements

For the

# Digital Aviation Weather Network (DAWN)

**11 February 1998**
**(Version 3)**

**DAWN Requirements**

This is a list of the operations requirements for the Digital Aviation Weather Network (DAWN). Phase I of this project is focused on a one-for-one replacement for current GS-200 and LABS functionality. However, comments on desired future enhancements are encouraged and should be identified as such and will be considered for incorporation in future Planned Product Improvements. Service B is initially planned to be accomplished through the "Micronesia" application developed by the Tech Center, but a recently developed Java script application has been approved by the Tech Center and may be the Service B implementation at IOC.

This is a time sensitive project with a projected in-service date of 01 Jun 98.

### *System Capability Requirements*

DAWN will provide timely and accurate certified weather, aeronautical information, and flight planning assistance to users of the NAS. To support this objective, the DAWN will provide the processing capability to acquire, store, retrieve and display information to support weather briefing, pre-flight planning, and in-flight operations. In addition, DAWN will provide remote access for specialists and pilots and general support functions to provide maintenance support and help functions for the users.

DAWN will ingest, store, process as required, retrieve and display data to provide the Flight Service (FS) specialists with certified textual weather data, weather graphic products (via AAWBS), and aeronautical information as support data for use in providing a weather briefing function. DAWN will provide the capability to receive this data from multiple sources simultaneously. DAWN will provide operator and site-adaptable parameters to support the processing of data into specific weather briefings. The weather briefing product consists of various reports and graphic displays required to present the briefing data.

All AFSS, FSS, and most CWO locations will receive certified weather data and aeronautical data from the NADIN II interface through DAWN via ANICS. (NAS-SS-1000, Vol. I; FAA 7110.10M)

a. DAWN, through the Service A module, will provide the FS specialists the certified textual weather data for use in providing a weather briefing function.

b. DAWN, through the AAWBS module, will provide the AFSS specialists the weather graphics for use in providing a weather briefing function.

c. DAWN, through the AAWBS module, will provide the AFSS specialists the weather satellite images for use in providing a weather briefing function.

d. DAWN, through the Service A&B modules, will provide the AFSS specialists the aeronautical information for use in providing a weather briefing function.

e. DAWN will provide the capability to simultaneous receive and process data from multiple sources.

f. DAWN will provide the capability to receive certified weather data from the WMSCR System via the NADIN II interface.

g. DAWN will provide the capability to receive aeronautical data from the WMSCR System via the NADIN II interface.

h. DAWN will provide the capability to receive aeronautical data from other NAS systems via the NADIN II interface.

i. DAWN will be flexible enough to allow expansion for additional user feeds.

**Additional System Requirements**

| Now | Future |
|---|---|
| -Manual reload | -Record all transactions |
| | -Data build/ Data validation capability |

**Interface Requirements**

-(FAA 7110.10M)
-AFTN (NADIN I, NADIN II)
-OCS
-WMSCR
- IDS-4

**Functional Requirements**

(FAA 7110.10M)

| Now | Future |
|---|---|
| -NOTAM accessibility | -NOTAM edit capability |
| -Two-way messaging system | - Automated flight strips |
| -Operator initiated Svc A selective save | - Archive of data accessed by individual specialist |
| -Request and Input Svc A data | |
| -Send/ Receive Svc B data | |
| -WMSCR partition | |
| -All /R, W, S, U, T, D, C functions and operators (Q, C, L, E, A, etc.) | |

-15 day on-line archive of
Service A and B data

## Availability Requirements

.9999 (NAS SS 1000, Vol. 1, p49)

## Maintenance Requirements

Now
Space/ Power
Hardware
Software
Functional baseline
Category C standard
COTS Equipment/ COTS Software

## Location Requirements

**DAWN User Locations**

| ITEM | LOCATION | FACILITY | ANICS STATUS | TERMS | PNTR |
|---|---|---|---|---|---|
| 1. | Fairbanks | AFSS | Installed | 9 | 2 |
| 2. | Juneau | AFSS | Installed | 7 | 2 |
| 3. | Kenai | AFSS | Installed | 11 | 5 |
| 4. | Kenai | ATCT | | 1 | 1 |
| 5. | Bethel | ATCT | Installed | 1 | |
| 6. | Bettles | CWO | Installed | 1 | |
| 7. | Cordova | CWO | Installed | 1 | 1 |
| 8. | Gulkana | CWO | Installed | 1 | 1 |
| 9. | Merrill | CWO | N/A | 1 | 1 |
| 10. | Tanana | CWO | Ordered | 1 | |
| 11a. | ZAN | CWSU | Installed | 1 | 1 |
| 11b. | ZAN | Flt. Data/Error Recovery | | 1 | 1 |
| 11c. | ZAN | FSDPS | | 1 | 1 |
| 11d. | ZAN | MCC | | 1 | 1 |
| 12. | Barrow | FSS | Installed | 2 | 2 |
| 13. | Cold Bay | FSS | Installed | 2 | 2 |
| 14. | Deadhorse | FSS | Installed | 2 | 2 |
| 15. | Dillingham | FSS | Ordered | 2 | 2 |
| 16. | Homer | FSS | Installed | 2 | 2 |
| 17. | Iliamna | FSS | Installed | 2 | 2 |
| 18. | Ketchikan | FSS | Installed | 3 | 2 |
| 19. | Kotzebue | FSS | Installed | 3 | 2 |
| 20. | McGrath | FSS | Installed | 2 | 2 |
| 21. | Nome | FSS | Installed | 3 | 2 |
| 22. | Northway | FSS | Installed | 2 | 2 |
| 23. | Palmer | FSS | None | 2 | 2 |
| 24. | Sitka | FSS | Installed | 3 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| 25. | Talkeetna | FSS | Installed | 2 | 2 |
| 26. | Annette | NWS | Installed | 1 | 1 |
| 27. | Barrow | NWS | Installed | 2 | 2 |
| 28. | Bethel | NWS | Installed | 1 | 1 |
| 29. | Cold Bay | NWS | Installed | 1 | 1 |
| 30. | King Salmon | NWS | Installed | 1 | 1 |
| 31. | Kodiak | NWS | Installed | 1 | 1 |
| 32. | Kotzebue | NWS | Installed | 1 | 1 |
| 33. | McGrath | NWS | Installed | 1 | 1 |
| 34. | Nome | NWS | Installed | 1 | 1 |
| 35. | St. Paul | NWS | Installed | 1 | 1 |
| 36. | Unalakleet | NWS | Installed | 1 | 1 |
| 37. | Valdez | NWS | None | 1 | 1 |
| 38. | Yakutat | NWS | Installed | 1 | 1 |
| 39a. | Anchorage AFOB | AT Div. | N/A | 1 | 1 |
| 39b. | Anchorage AFOB | NWSRO | | 3 | 2 |
| 39c. | Anchorage AFOB | ROC | | 1 | 1 |
| 40. | Anchorage | WSCMO | N/A | 1 | 1 |
| 41. | Anchorage | WSFO | N/A | 3 | 2 |
| 42. | Fairbanks | WSFO | Installed | 2 | 1 |
| 43. | Juneau | WSFO | Installed | 2 | 1 |
| 44. | Fairbanks | WSO | Installed | 1 | 1 |
| 45. | Palmer | Tsunami Warn. Center | None | 1 | 1 |
| 46. | Elmendorf | USAF | None | 3 | 3 |
| 47. | Eielson | USAF | None | 3 | 3 |
| 48. | Kulis | AKANG | None | 1 | 1 |
| 49. | Air Sta. Kodiak | USGS | None | 1 | 1 |
| 50. | Air Sta. Sitka | USGS | | 1 | 1 |
| 51. | NA-SMO | MCC | | 1 | 1 |
| 52. | FISO | | | 1 | 1 |
| TOTALS | | | | 110 | 81 |

3.2.1.2.3 Flight planning Performance characteristics. The NAS shall provide flight planning services to the user/specialist as follows:

a. Validate and process proposed flight plans and amendments to proposed
- - flight plans, and respond to the user/specialist, within 10 seconds of a request;

b. Validate and process active flight plans within 10 seconds for probe and route amendments and within 10 seconds for all other cases;

c. Provide flow control and delay advisory information to the user in accordance with 3.2.1.2.2;

d. Provide alerts within 1 minute after detection of an aircraft that is operating in NAS airspace using the registration number of a reportedly stolen aircraft;

e. Provide alerts if the surveillance coverage of and contact with an aircraft receiving flight following service has not been re-established within 15 minutes of the expected report time;

f. Provide alerts when the difference between the current time and the users estimated time of arrival at the destination exceeds 30 minutes;

g. Determine the location of an aircraft equipped with a functioning radio to within 1 mile of its actual position with respect to two separate known, geographical positions;

h. Receive and store all NAS ground-to-ground inter-facility and intra-facility communications, retain them in off-line storage for at least 30 days, and retrieve them from off-line storage within 5 minutes of a request by an authorized FM supervisor. The requirements of section 3.2.1.2.8.3 also apply;

i. Provide current, routine and hazardous weather information within 10 seconds of a request. The requirements of section 3.2.1.2.4 also apply;

j. Maintain current weather surface observations updated locally and nationally in accordance with the requirements of section 3.2.1.2.4;

k. Maintain hazardous weather information current locally within 2 minutes, and nationally within 30 minutes, in accordance with section 3.2.1.2.4;

1. Acquire and maintain forecast weather information and make it available within 10 seconds of a request, in accordance with section 3.2.1.2.4;

m. Provide a national aeronautical and weather data base with sufficient capac

3.2.1.2.3.1 User inputs. The NAS shall begin communication with user input/output devices within 5 seconds of connection.

3.2.1.2.4 Weather Performance characteristics. The NAS shall provided services to the user/specialist for weather and NOTAM information.

a. The NAS shall acquire weather and NOTAM information as follows:

1. Detect the current surface weather conditions at selected airports at least once every minute;

2. Detect the current weather conditions aloft at least once every 5 minutes for all airspace within the NAS area of responsibility, as follows:

   a) En route: Shall be from 6000 feet above ground level (AGL) to 60,000 feet mean sea level (MSL);

   b) Terminal: Shall be from ground level to 10,000 feet AGL within 45 nmi of designated airports.

3. Collect satellite imagery data at least once every 30 minutes;

4. Collect NWS generated data as follows: a) Terminal forecasts, at least once every 6 hours; b) Area forecasts, at least once every 12 hours; c) Winds aloft forecasts, at least once every 12 hours;

   d) Current surface weather observations, at least once every minute;

   e) Current weather conditions aloft, at least once every 5 minutes;

   f) Weather warnings and advisories, within 15 seconds, after generation.

5. Collect DOD generated data on current surface weather observations at least once every minute;

6. Collect all pilot reported data within 15 seconds, after generation;

- 7. Collect all NOTAMs within 15 seconds, after generation.

b. The NAS shall disseminate weather and NOTAM information as follows:

1. Weather information classified as hazardous or potentially hazardous shall be available as follows:

   a) Terminal: Within one minute from the time NAS receives the hazardous weather information;

   b) En route: Within two minutes from the time NAS receives the hazardous weather information.

2. Current surface weather observation information shall be available to local area specialists and users and updated at least once per minute;

3. Current weather conditions aloft information shall be available to local area specialists and users and updated at least once every 5 minutes;

4. Current surface weather observation information shall be available to non-local area specialists and users and updated at least once per hour;

5. Weather conditions aloft information shall be available to . non-local area specialists and users upon request and updated at least once per hour;

6. Locally stored weather/aeronautical information to be accessible to the users with or without the aid of a specialist with mean response time of 3 seconds, 99th percentile response time of 5 seconds and a maximum response time of 10 seconds, from time of request for information;

7. Support 24 hour access by telephone, G/A communication link, user terminal or person-to-person for weather/aeronautical information of a specified route of flight, geographic area or location;

8. Support mass weather dissemination to users within 150 nmi of a weather phenomenon.

c. The NAS shall maintain weather and NOTAM information as follows:

1. Trend weather information for the past 3 hours;
~ - 2. Forecasted weather information as follows:

a) Terminal forecasts, which cover the next 24 hours; b) Area forecasts, which cover the next 24 hours; c) Winds aloft forecasts, which cover the next 30 hours; d) En route area advisories, which cover the next 12 hours.

3. Satellite imagery data for the past 8 hours;

4. Maintain hazardous weather information until the hazard has dissipated. Expired hazardous weather information shall be purged when the hazard no longer exists, no longer affects or has the potential to affect the safe and efficient movement of aircraft within:

a) One minute for terminal operations; b) Two minutes for en route operations; c) Thirty minutes nationally.

5. Maintain NOTAMs until expired, expired NOTAMs shall be purged within 1 hour.

d. The NAS shall classify all weather information by location, route and/or geographic area to facilitate its use as follows:

1. Weather information shall be available for route-oriented retrievals along a corridor up to 200 miles wide along a specified route/altitude of flight;

2. Weather information shall be available for area-oriented retrievals and include weather information within a radius of 100 miles from the user/specialist defined location;

3. Weather information shall be available by location, weather-type, or time (current vs. forecast).

e. The NAS shall perform all processing required to produce and/or complete a description of the current, trend, or predicted weather conditions by:

1. Deriving from raw data the products needed by NAS specialists and users;

2. Using automated weather detection systems;

3. Expanding coded weather data into plain English;

4. Filtering, decoding, editing and reformatting acquired weather data to facilitate its operational use by NAS specialists and users;

5. Animation overlaying and composition weather data to facilitate its operational use by NAS specialist and users.

f. The NAS shall construct a real-time depiction of the weather conditions which affects, or has the potential to affect, the safe and efficient movement of aircraft:

1. At least every 15 minutes for each ATCT, ACE, ATCCC area of responsibility;

2. Includes the current condition and near-term predictions of the following: thunderstorm location and intensity, precipitation areas, cloud coverage, cloud tops, icing levels, turbulence, winds aloft, clear air turbulence, low level wind shear, and areas of IFR, MVFR, and VFR;

3. At 5 minute intervals to provide for at least 20 minutes advanced warning of sustained wind shifts to the NAS specialists for use in planning airport operations;

4. Allowing user/specialist to receive at least a one (1) minute warning prior to the existence of hazardous weather data (i.e., microburst, gust front) in the terminal area.

g. The NAS shall archive all weather information in accordance with section 3.2.1.2.8.3;

h. The NAS shall perform all NOTAM processing by:

1. Expanding coded NOTAM information into plain English;

2. Filtering, decoding, editing and reformatting the NOTAM information to facilitate its operational use by NAS specialists and users;

3. Dividing the data for area-oriented retrievals within a radius of 100 miles from the user/specialist defined location.

h. Independent emergency voice communications within 1 minute after an emergency voice situation in the NAS has been identified;

i. The number of direct-access (DA) and indirect-access (IA) calls that are blocked between designated FM facilities shall not exceed 1 in 1000 calls;

j. The number of commercial IA calls to other F. M manned facilities that are blocked shall not exceed 1 in 20 calls.

. _ d

3.2.1.2.8.3 Data and voice archiving Performance characteristics. The NAS shall provide data and voice storage, recording and playback capabilities for reconstruction purposes as follows:

a. Record all specified operational voice ant data information for support of analysis e.g., incident/accident investigation, search and rescue operations, or training activities;

b. Retrieve and playback all specified recorded data and voice information requested by an authorized specialist as follows:

1. Voice recordings retrievable within 30 minutes from on-line storage and within 60 minutes from off-line storage;

2. Data recordings retrievable from off-line storage.

c. Store all operational data and voice recordings in accordance with appropriate FM procedures, as follows:

1. Voice transmissions for 15 days minimum; 2. Data information for 15 days minimum.

3.2.1.2.8.4 NAS time standard Performance characteristics. The NAS shall provide a standard time signal as follows:

-

a. A system dealing with operational control of aircraft and voice recording shall be synchronized to within 100 msec of universal time coordinated (UTC);

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,

b. A system dealing with non-ATC functions (e.g., maintenance, weather, traffic management, flight planning) shall be synchronized to within 6 seconds of UTC;

-

c. The NAS shall provide interfacing capabilities to the coded time signal and synchronization in accordance with Volumes II through V of NAS-SS-1000;

d. The NAS shall provide subsystems the capability to synchronize to that subsystem's own time source.

## ATTACHMENT 2  AWIPS for ARONET

Date: Jan. 11, 1999

To: Jim Kemper

Through: Paul McCloud

From: Phil Dutton

Subject: Need for AWIPS as a replacement for ARONET

In Alaska, we have been using the Alaska Region's Operational Network (ARONET) system instead of the Remote Terminal to AFOS (RTA) to augment the Harris Corporation's Weather and Radar Processor (WARP). AWIPS is replacing ARONET region wide at all the Alaskan forecast offices. In the lower 48, AWIPS is replacing AFOS.

In order to maintain training pace with the forecast offices and the high quality of support to the FAA, the Alaska Region's Center Weather Service Unit (CWSU) needs AWIPS.

WARP is a good analysis displaying machine. However, it has a major draw back dealing with forecast model viewing. ARONET, and also AWIPS, handles the displaying of model data in a very productive display.

The data can be manipulated and enhanced locally on ARONET. Data fields can be derived on ARONET such as thickness and theta E.

WARP is a closed system. You can not import into it or export from it with the exception of exporting graphics to briefing terminals.

At the Alaska CWSU, a program has been setup for working with NASA on a Total Ozone Mapping Spectrometer (TOMS) project. This program functions through the use of ARONET and its importing and exporting capabilities. It also functions through the data manipulation capabilities of the ARONET program called “xmMap”. The benefits of this TOMS project will be the increased accuracy of turbulence forecasting, the increased precision and uniformity of model initialization, and the more exact tracking of volcanic ash.

The following ARONET / AWIPS functions are presently being used at the Alaska CWSU to augment the WARP system in producing precise and timely forecasts to the FAA. The lose of these functions will dramatically impact and degrade our mission.

**WARP does not have the capacity for handling the following functions.**

- *Weather Display function*:

  - additive data:

    - displaying 6 hour and 24 hour precipitation
    - displaying 12 hour and 24 hour maximum and minimum temperatures

  - location information identification:

    - enter station id, outputs call sign (3 and 4 letters), station elevation, station's latitude and longitude.

  - Tools:

    - convert Fahrenheit to Celsius and back.
    - convert mph to knots and back
    - convert altimeter setting to Mean Sea Level
    - compute relative humidity from T and Td.
    - compute wind chill from T and Knots
    - display a time series of relative humidity for a station.
    - display a time series of wind chills for a station.
    - display current pressure difference tables for various stations. Used for predicting surface winds.
    - compute forecast pressure difference tables for various stations.
    - display freezing levels

- *Climate*:

  - observed, normals, and extremes for:

    - maximum temperatures
    - minimum temperatures
    - average temperatures
    - precipitation
    - snowfall
    - snow on the ground
    - degree days

**WARP does not have the capacity for handling the following functions.**
*(cont.'d)*

- *HIPS* (High-resolution Image Processing System):

  - displaying the following sectors:

    - HRPT:
      - a1
      - a2
      - j1

    - DMSP:
      - a1
      - a2
      - ab
      - ac
      - af
      - ak
      - f1
      - f2
      - j1

      kk (critical during Kamchatka volcanic eruptions)

    - GMS:

      - 1kamf
      - 2nhemf

      2wp (critical during Kamchatka volcanic eruptions)
      - 2wpf

  - distance on WARP is calculated from nearest reporting station not cursor location. This creates a built-in error. ARONET's HIPS Focus software reports distances from actual point on satellite display to actual point. Timing of a particular feature is therefore much more accurate.

  - distance displayed in kilometers and statue miles

  - pixel information, such as exact latitude and longitude as well as temperature

  - tilt image function, controlling tilt and amplification

**WARP does not have the capacity for handling the following functions.**
*(cont.'d)*

- *Cross Sections*:

  - display of:

    - wind sheer
    - vector component
    - pressure
    - vertical velocity

- *SunMoon*:

  - Sunrise/set:

    - displaying sunrise and sunset times for a given station. It also includes twilight times, max solar elevation, length of daylight and change, and azimuth rise and set.

  - Moon rise/set:

    - displaying moon rise and moon set times for a given station. It also includes maximum elevation and phase as well as azimuth rise and set.

- *Time Series*:
  - display a times series for the following features:

    - wind
    - wind speed
    - wind shear
    - vector components
    - temperature
    - dew point
    - Theta
    - Theta-E
    - relative humidity
    - pressure

- Volcanic Response program

  - run the Puff model and display output

**<u>WARP does not have the capacity for handling the following functions.</u>**

*(cont.'d)*

- *xmMap*:

  - User definable scripts to better handle:

- looping
- overlaying
- objective analysis
- field calculations
- multiple panel displays

- Some Data / Model Manipulative features:

  - thickness calculations
  - advection of sea level pressure
  - convergence
  - divergence
  - change between projection periods:

    - height
    - temperature
    - vorticity
    - sea level pressure

  - vertical temperature differences
  - vertical wind shear
  - Theta-E calculations
  - geostrophic relative / absolute vorticity
  - Q-vectors
  - this list could continue...

- *xmSkewT*:

  - display forecast soundings for MOS data points easily using either NGM or ETA model data.

  - setup user defined defaults and profiles easily.

  - manipulate sounding with on-the-fly re-calculations of stabilities.

Date: Jan. 11, 1999
Apr. 11, 1999 **Updated** Memo

To: Jim Kemper

Through: Paul McCloud

From: Phil Dutton

Subject: Need for AWIPS as a replacement for ARONET

**ZAN Comment (4/11/99):** In keeping with the numbering theme that the original responses came back with, I have renumbered this complete document. The new numbering scheme may lessen the confusion of which items belong to which groups.

Once again, ***note*** the subject line above. This paper is justification for replacing ARONET with AWIPS, not for replacing or modifying WARP.

Also please note, the *Harris Corporation comments* below were rendered in part if not wholly by Russ Sinclair, meteorologist, at Harris Corporation.

1. In Alaska, we have been using the Alaska Region=s Operational Network (ARONET) system instead of the Remote Terminal to AFOS (RTA) to augment the Harris Corporation=s Weather and Radar Processor (WARP). AWIPS is replacing ARONET region wide at all the Alaskan forecast offices. In the lower 48, AWIPS is replacing AFOS.

*Harris Comment: AERONET/RTA will not be deleted in the near future. LDAD can provide the information but other requirements (e.g. DOD) should be addressed.*

**ZAN Comment (4/11/99)**: As ARONET functions migrate into AWIPS, those functions will not be supported on ARONET any longer. Therefore, while ARONET may not physically go away for some time, the functionally of ARONET will drastically decrease with time.

2. In order to maintain training pace with the forecast offices and the high quality of support to the FAA, the Alaska Region=s Center Weather Service Unit (CWSU) needs AWIPS.

3. WARP is a good analysis displaying machine. However, it has a major draw back dealing with forecast model viewing. ARONET, and also AWIPS, handles the displaying of model data in a very productive display.

4. The data can be manipulated and enhanced locally on ARONET. Data fields can be derived on ARONET such as thickness and theta E.

*Comment. WARP supports theta E and thickness fields. Isopleths of observed and model data with Item TH allows the user to select a top and bottom pressure level to display thickness. Theta E under isopleths is item – EPT.*

**ZAN Comment (4/11/99)**: The key word here is "manipulate". On ARONET/AWIPS not only can the levels be determined, but also mathematical processes can be performed. Example…Comparing the change in the relationship between the upper level thickness and the low level thickness through time. On ARONET/AWIPS there is a multitude of computations that can be performed on data. In this given case, something as simple as subtraction carried through time is a valuable tool. As cooling aloft occurs with warming below the atmosphere becomes more unstable. Aviation hazards such as thunderstorms and their severity can be detailed more accurately by using ARONET/AWIPS.

5. WARP is a closed system. You can not import into it or export from it with the exception of exporting graphics to briefing terminals.

*Comment. WARP can also export text to the briefing terminals. WARP imports HIPS data (all the HRPT and DMSP sectors). WARP Stage 1 also allows Met Workstation users to send graphics to WARP Met Workstation users at other sites. Does AWIPS allow users to communicate between sites – or for that matter import and export data. There is also an ECP planned for WARP that would provide access to gridded data for other systems at the ARTCCs.*

**ZAN Comment (4/11/99)**: Yes, text as well as graphics can be exported to the briefing terminals (BTs). For the purposes of this discussion however, it should be noted that the briefing terminals are an integral part of the WARP system. These BTs are directly connected to WARP without any external connections directed to them. Therefore exporting to the BTs is just sending information to another part of the same system.

Here in Alaska we have been selected to work on a joint FAA / NWS / NASA project called TOMS (Total Ozone Mapping Spectrometer) project. The benefits of this project are expected to be increased accuracy in turbulence forecasting as well as better tracking of volcanic ash. A satellite image from the TOMS project, enhanced using the capabilities of ARONET/AWIPS would be very beneficial at map briefing times.

Currently it is not possible to import such a graphic image from any other (non-WARP) computer system into the WARP system.

Coordination between weather offices (including non-CWSU offices) is presently a high priority with NWS. It is not possible at this time to export a graphic that was created on WARP into any other (non-WARP) computer system. Example…A surface chart was created displaying ceiling and visibility information, fronts, placement of highs and lows, and current or forecast weather. This graphic, if exportable, could be placed on a NWS computer system, such as ARONET/AWIPS for coordination between the offices.

6. At the Alaska CWSU, a program has been setup for working with NASA on a Total Ozone Mapping Spectrometer (TOMS) project. This program functions through the use of ARONET and its importing and exporting capabilities. It also functions through the data manipulation capabilities of the ARONET program called AxmMap@. The benefits of this TOMS project will be the increased accuracy of turbulence forecasting, the increased precision and uniformity of model initialization, and the more exact tracking of volcanic ash.

7. The following ARONET / AWIPS functions are presently being used at the Alaska CWSU to augment the WARP system in producing precise and timely forecasts to the FAA. The loss of these functions will dramatically impact and degrade our mission.

8. WARP does not have the capacity for handling the following functions.

**ZAN Comment (4/11/99)**: Harris placed a numbering system onto the original document when their comments were added. We renumbered that system when we added our comments to better match the flow of the original document. Number 7 and 8 above are still valid points and could easily be combined into one number. However, that would change all subsequence numbers. To avoid this under taking, this comment was added.

9. Weather Display function:

9.1 additive data:

9.1.1 displaying 6 hour and 24 hour precipitation

9.1.2 displaying 12 hour and 24 hour maximum and minimum temperatures

*Harris Comment: WARP generates displays of precipitation forecasts from gridded model data at 6 hr intervals from 6 to 48 hours. WARP also generates displays of 12 and 24 hour max/min temps from gridded model data. Precip displays are: ISO PPTN (convective/non-convective precip); ISO PCPN (total non-convective precip); and ISO PCPC (total convective precip). Temperature displays are ISO TMP.*

**ZAN Comment (4/11/99)**: Additive data specifically implies amounts or totals of the recent past. (not forecasts) In the ARONET/AWIPS Weather Display program, the user can display the 6hr or 24hr precipitation totals. The user can also look at the maximum and minimum temperatures for the last 12 and 24 hours.

9.2 location information identification:

9.2.1 enter station id, outputs call sign (3 and 4 letters), station elevation,
station=s latitude and longitude.

*Harris Comment: Interrogate function allows user to enter a 3 letter station id, positions the cursor on a map at the station location; the real-time latitude-longitude readout displays the station's latitude longitude in the lower window bar.*

**ZAN Comment (4/11/99)**: The Interrogate function does as advertised. The user can enter a 3 letter id and the station name with latitude and longitude prints out. The user can enter a 4 letter id and the station name and lat/long prints out. However, a new employee or someone new to the ARTCC may not know both the 3 and the 4 letter ids. The 3 letter id's are used on pireps. The 4 letter id's are used on observations. On ARONET/AWIPS, the user can enter either option and both 3 and 4 letter ids will print out along with the name of the site. Additionally, station elevation prints out on ARONET/AWIPS not on WARP. Elevation is needed for forecasting pressure/density altitudes as well as useful information for such conditions as up slope weather events.

9.3 Tools:

9.3.1 convert Fahrenheit to Celsius and back.

*Harris Comment: The user can change the units for isopleths and plots from Fahrenheit to Celsius and back by adjusting the default setups.*

**ZAN Comment (4/11/99)**: The same is true on ARONET/AWIPS. In the category "Tools" are programs for use by the meteorologist to accomplish routine specialized tasks. In this instance, the user can physically enter a Celsius number and the program will convert it to Fahrenheit and vice versus. This feature is not available on WARP.

### 9.3.2 convert mph to knots and back

*Harris Comment: The user can change the units for isopleths and plots from Fahrenheit to Celsius and back by adjusting the default setups.*

**ZAN Comment (4/11/99)**: In the category "Tools" are programs for use by the meteorologist to accomplish routine specialized tasks. In this instance, the user can physically enter a unit of knots number and the program will convert it to MPH and vice versus. This feature is not available on WARP.

### 9.3.3 convert altimeter setting to Mean Sea Level

*Harris Comment: Altimeters are suppose to show the height above MSL. Should this read convert feet msl to meters msl?*

**ZAN Comment (4/11/99)**: The altimeter setting is the pressure value that an aircraft's altimeter is set at to show field elevation above MSL. MSL is the pressure value obtained by theoretical reduction of barometric pressure to sea level. Altimeter settings are expressed in "inches". MSL is usually expressed in millibars. Whereas heights above MSL are most commonly expressed in feet above MSL.

This ARONET/AWIPS program converts (altimeter) inches into (MSL) millibars. To perform this conversion the ARONET/AWIPS program uses the altimeter setting, current or average 12hr temperature, annual average temp, and station elevation. The output is expressed in millibars.

The user can isopleth various features such as MSL or Altimeters on WARP as well as ARONET/AWIPS. Nevertheless, the capability of converting "an" altimeter setting to MSL is missing on WARP.

When MSL pressures reach 10.50mb (an annual occurrence here) the equivalent altimeter setting approaches and exceeds the capability of the altimeter itself. At this point, without other supporting devices such as a vertical height radar, the pilot becomes blind as to the height of the aircraft. In mountainous terrain or adverse weather, this becomes a very real aviation hazard.

### 9.3.4 compute relative humidity from T and Td.

*Harris Comment: Available for plots and Isopleths*

**ZAN Comment (4/11/99)**: The ability to display relative humidity on a chart is available. The ability to compute RH from T and Td for a given site and/or display a series of RH values for an individual station especially over time is not available on WARP.

### 9.3.5 compute wind chill from T and Knots

### 9.3.6 display a time series of relative humidity for a station.

### 9.3.7 display a time series of wind chills for a station.

### 9.3.8 display current pressure difference tables for various

stations. Used for predicting surface winds.

*Harris Comment: Three hour pressure changes available.*

**ZAN Comment (4/11/99)**: The "app" is available on WARP. In addition to "app" the feature on ARONET/AWIPS displays actual pressure differences between user selected stations. In mountainous terrain, the greater the pressure difference from one side of the mountain to the other the greater the wind. The greater the wind speed the greater chance of turbulence, up slope, precipitation, associated icing, and reduced visibilities.

9.3.9 compute forecast pressure difference tables for various stations.

9.3.10 display freezing levels

*Harris Comment: Freezing level isopleths are available*

**ZAN Comment (4/11/99)**: Freezing level isopleths are available. But, the data only covers the extreme southeast portion of ZAN airspace. ARONET/AWIPS data covers all stations in Alaskan airspace.

10. Climate:

10.1 observed, normals, and extremes for:

10.1.1 maximum temperatures

10.1.2 minimum temperatures

10.1.3 average temperatures

10.1.4 precipitation

10.1.5 snowfall

10.1.6 snow on the ground

10.1.7 degree days

*Harris Comment: Available from alphanumeric climate reports and AWOS/ASOS. Climatology is available from NCDC.*

**ZAN Comment (4/11/99)**: It is true that climatology data is appended on some forecasts. Many if not most sites do not have this data appended to their forecast. This data is available through other external sources, however real time access to these sources is not practical. ARONET/AWIPS has a data base which is real time accessible.

11. HIPS (High-resolution Image Processing System):

*Harris Comment: WARP imports and displays all the HRPT and DMSP sectors from the HIPS workstation at the ARTCC. WARP receives GMS IR, VIS, and WV data via the Harris Weather Data Service. Harris receives GMS data at our Hub via commercial satellite and distributes it in our satellite data stream (this data will be accessible in Stage 1). Zoom capability can display areas of interest*

**ZAN Comment (4/11/99)**: The ZAN CWSU does not receive <u>any</u> DMSP images or GMS images on WARP. We do receive HRPT images except for the ones listed below.

11.1 displaying the following sectors:

11.1.1 HRPT:

11.1.1.1 a1

11.1.1.2 a2

11.1.1.3 j1

11.1.2 DMSP:

11.1.2.1 a1

11.1.2.2 a2

11.1.2.3 ab

11.1.2.4 ac

11.1.2.5 af

11.1.2.6 ak

11.1.2.7 f1

11.1.2.8 f2

11.1.2.9 j1

11.1.2.10 kk (critical during Kamchatka volcanic eruptions)

11.1.3 GMS:

11.1.3.1 1kamf

11.1.3.2 2nhemf

11.1.3.3 2wp (critical during Kamchatka volcanic eruptions)

11.1.3.4 2wpf

11.2 distance on WARP is calculated from nearest reporting station not cursor location. This creates a built-in error. ARONET=s HIPS Focus software reports distances from actual point on satellite display to actual point. Timing of a particular feature is therefore much more accurate.

*Harris Comment: WARP calculates great circle distance between the lat/lon pairs identified by cursor positioning and mouse activation.*

**ZAN Comment (4/11/99)**: Upon more experimenting with both WARP and ARONET software, it became apparent that WARP does not calculate distance from nearest reporting station as earlier thought. The information that was received from meetings with Harris personnel was not entirely accurate. The software does display the nearest reporting station when calculating distance. This fact lends erroneous substance to the earlier misinformation from Harris. In any event this item is now a mute point.

11.3 distance displayed in kilometers and statue miles

*Harris Comment: WARP displays distance in kilometers, statute miles and nautical miles.*

**ZAN Comment (4/11/99)**: In the "Interrogate" mode, the distance units on WARP is in nautical miles. There is no visible way of representing the units in kilometers or statue miles.

11.4 pixel information, such as exact latitude and longitude as well as temperature, tilt image function, controlling tilt and amplification.

*Harris Comment: WARP Stage 1 displays latitude, longitude and temperature*

**ZAN Comment (4/11/99)**: This document was based on a snap shot image of current systems. At this time, there is no image information for temp on WARP. If the discussion were to include features that will be available years from now, there probably would not be any discussion necessary now. In addition, the tilt feature is useful during the convection season for viewing flight impacts due to thunderstorm cell development.

12. Cross Sections:

12.1 display of:

12.1.1 wind sheer

*Harris Comment: Available on WARP hodograph*

12.1.2 vector component

*Harris Comment:  Available using gridded data sources; mean wind vector is available with warp hodograph.pressure*

12.1.3 pressure

12.1.4 vertical velocity

*Harris Comment:  Available as omega using gridded data as the source data.*

**ZAN Comment (4/11/99)**:   (In reference to the above 12.1.1 - 12.1.4) In the Operation and Program Manual for WARP dated Jan. 8, 1998 neither the index nor the table of contents make any reference to a hodograph. As of this date, it may be a feature that does not exist.

13. SunMoon:

13.1 Sunrise/set:

13.1.1 displaying sunrise and sunset times for a given station. It also includes twilight times,  max solar elevation, length of daylight and change, and azimuth rise and set.

*Harris Comment:  Sunrise/set is available from alphanumeric climate reports*

**ZAN Comment (4/11/99)**:   It is true that climatology data is appended on some forecasts. Many if not most sites do not have this data appended to their forecast. This data is available through other external sources, however real time access to these sources is not practical. ARONET/AWIPS has a data base which is real time accessible. In addition to the original parameters list above in 13.1.1, also include solar noon.

13.2 Moon rise/set:

13.2.1 displaying moon rise and moon set times for a given station. It also includes maximum elevation and phase as well as azimuth rise and set.

*Harris Comment:  Sunrise/set is available from alphanumeric climate reports*

**ZAN Comment (4/11/99)**:   Same as above.

14. Time Series:

14.1 display a times series for the following features:

14.1.1 wind

14.1.2 wind speed

14.1.3 wind shear

14.1.4 vector components

14.1.5 temperature

14.1.6 dew point

14.1.7 Theta

14.1.8 Theta-E

14.1.9 relative humidity

14.1.10 pressure

*Harris Comment: Is this observed or forecasted?*

**ZAN Comment (4/11/99)**: For RAOB cross section values, it is observed. For the rest, it is forecasted.

## 15. *Volcanic Response program*

### 15.1 run the Puff model and display output

*Harris Comment: Is there a requirement to run the model or to have the results of the model?*

**ZAN Comment (4/11/99)**: Alaskan Airspace is almost constantly affected by volcanic eruptions. Whether it is Alaskan volcanoes or Russian volcanoes on the Kamchatka Peninsula.

When volcanic ash enters a hot engine it turns to glass. This glassification stops the engine. This process was evidenced when a B747 lost all four engines and tens of thousands of feet in altitude before it was able to successfully restart two engines only hundreds of feet above the ocean surface.
Volcanic ash is very abrasive. Even in a light condition, volcanic ash can scrape the paint off of the leading edges of aircraft. It can also scratch the windows to the degree of impairing vision completely.

Here at ZAN CWSU we work closely with the Alaska Volcano Observatory which also works closely with their Russian counterparts. Upon notification that a volcano is erupting, we use all available means to determine the vertical and horizontal extent of the ash cloud. Of major importance is the trajectory of the ash cloud. To determine the track the cloud will move, models and their output are used. Models such as the Puff , CANERN, and VAFTAD models. In addition to these models, regular forecasting models used are ETA, NGM, AVN, MRF, ECMF, and EGRR. Having these models is a primary requirement.

## 16. *xmMap*:

### 16.1 User definable scripts to better handle:

16.1.1 looping

16.1.2 overlaying

### 16.1.3 objective analysis

### 16.1.4 field calculations

### 16.1.5 multiple panel displays

*Harris Comment: WARP has looping with extensive looping control. WARP has an automatic product generator that can be "scripted" to overlay, perform contouring which can include objective analysis. WARP has multiple windows that can be arranged as four panels.*

**ZAN Comment (4/11/99)**: WARP can loop. WARP can not synchronously loop up to four panels. In the old Facsimile days, the LFM would arrive in four panels. The 500mb height contour and vorticity was in one panel. The 700mb height contour and relative humidity was in another. The vertical motion and precipitable water was in another. Finally MSL surface pressure and 1000-500mb thickness was in the last panel. ARONET/AWIPS has the capability to loop all four panels at once for any model. ARONET/AWIPS can also loop a four panel of any product the forecaster needs. It could be 1000-500mb thickness for four different models. The four panel could be three different levels (850,700,& 500mb) of relative humidity with the fourth panel the average for the whole atmosphere. By having the ability to loop all four panels synchronously, the date time of each panel matches the other three exactly.

WARP can overlay and contour. WARP can not perform the mandatory calculations and data manipulations on gridded data with color enhanced user definable portion fields. The mathematical possibilities of data manipulations are almost endless with ARONET/AWIPS. ARONET/AWIPS does so much more than just contour or overlay.

## 16.2 Some Data / Model Manipulative features:

### 16.2.1 thickness calculations

*Harris Comment: Thickness contouring is available. There are a series of standard thicknesses and the user can even define his own.*

**ZAN Comment (4/11/99)**: AFOS has thickness charts and WARP can display them. On ARONET/AWIPS a lot more can be done. The user can write a script that calculates the thickness for 1000-700mb and also 700mb-400mb. Then xmMap (ARONET/AWIPS) can take the difference of the two layers. The user can then have the script color enhance just the difference values of concern and animate out through time. When cold air aloft moves in as warm air below advects in then destabilization of the atmosphere occurs. This output can also be overlaid on other derived products and satellite images. This product highlights area of destabilization. This process lends it self to enhanced precipitation, limitation to visibility, turbulence due to convection, and potentially icing improved forecasting.

### 16.2.2 advection of sea level pressure

### 16.2.3 convergence

*Harris Comment: Moisture convergence is available*

**ZAN Comment (4/11/99)**: Similar to our comment above, xmMap (ARONET/AWIPS) can manipulate, calculate, and derive fields not available elsewhere (user definable fields/products).

Convergence of any kind is calculable via xmMap. In example given above ( Moisture ), can WARP calculate, animate, and color enhance the difference between period one and period two? No. xmMap can. XmMap can calculate the amount of divergence aloft or convergence in the lower levels. It can display this information showing the change over time, color enhancing only the regions of concern, and then applying the output to other products, derived or otherwise.

### 16.2.4 divergence

*Harris Comment: Divergence is available*

**ZAN Comment (4/11/99)**: See comment above.

### 16.2.5 change between projection periods:

#### 16.2.5.1 height

#### 16.2.5.2 temperature

#### 16.2.5.3 vorticity

#### 16.2.5.4 sea level pressure

### 16.2.6 vertical temperature differences

*Harris Comment: Available as 12 and 24 hour changes*

**ZAN Comment (4/11/99)**: On ARONET/AWIPS the changes can be calculated for any interval from 3hr to 6hr, 12hr, 24hr, and more. The output can then be highlighted, animated, and combined with other products.

### 16.2.7 vertical wind shear

*Harris Comment: Available on hodograph*

**ZAN Comment (4/11/99)**: In the Operation and Program Manual for WARP dated Jan. 8, 1998 neither the index nor the table of contents make any reference to a hodograph. As of this date, it may be a feature that does not exist.

### 16.2.8 Theta-E calculations

*Harris Comment: Available*

### 16.2.9 geostrophic relative / absolute vorticity

*Harris Comment: Available*

### 16.2.10 Q-vectors

*Harris Comment: Available*

### 16.2.11 this list could continue...

**ZAN Comment (4/11/99)**: (for 16.2.8-16.2.11) The above comparison is best handled by listing all of the functions of ARONET/AWIPS xmMap. The list will be sent separately because of its length.

## 17. *xmSkewT*:

### 17.1 display forecast soundings for MOS data points easily using either NGM or ETA model data.

*Harris Comment: Available*

**ZAN Comment (4/11/99)**: As of this date, this feature is not working on WARP. On ARONET/AWIPS the forecaster can plot the soundings for some stations that do not send up RAOBs. The program works off of gridded data from various models.

### 17.2 setup user defined defaults and profiles easily.

*Harris Comment: Available*

**ZAN Comment (4/11/99)**: WARP has this capacity however ARONET/AWIPS has more numerous useful selectable features.

### 17.3 manipulate sounding with on-the-fly re-calculations of stabilities.

*Harris Comment: Available through interactive Skew-T*

**ZAN Comment (4/11/99)**: Not only does ARONET/AWIPS have more useful features, it has user definable scripts to cut down some of the repetitiveness setup for features displayed.

Legibility is worse on WARP when displaying skewT soundings. If the user enlarges the sounding to increase legibility then the sounding layer data printed on the side as well as the stability data on the bottom disappears.

*Harris Comment: In all the above there is no mention of the model used for this data. We asked for an updated list of model requirements and did not receive one.*

*In the above list it appears that it is more a desire to see a different display rather than a new capability. We agree that new models, human factors and ease of use needs to be incorporated into WARP. Additionally, professional training programs are scheduled for the CWSU on WARP (according to Mr. John Kelly at the American Meteorological Society Annual Meeting, January 1999).*

**ZAN Comment (4/11/99)**: The models that we routinely use are:

ETA T and U grids
NGM N grid
AVN A and J grids
MRF A and J grids
ECMF A and J grids
EGRR A grid
Puff
CANERN
VAFTAD

Models that are being developed for use:
Nogaps A and J grids
Sef A and J grids

To address the second statement, it may seem like a desire but it is not. We presently have capabilities that will no longer exist with the loss of ARONET and without the replacement by AWIPS. These are real needs, not just wishes for a different display.

All the above ZAN comments (4/11/99) are aimed at the fact that we have certain abilities due to the current software available on ARONET/AWIPS. These programs are used everyday and are needed everyday. To remove these programs, that is take away ARONET without replacing it with AWIPS would drastically reduce the effectiveness of our operations and the high standard of support we presently provide to the FAA for aircraft safety.

Attachment 3  AAWBS NEXRAD Products

Subject: **ACTION**: Update to NEXRAD Product Requirements

Date: April 1, 1999

From: Manager, Air Traffic Division, AAL500

Reply to Attn. of: James (Kimo) Villar
(907) 271-5902
FAX: (907) 271-2791

To: Director, National Weather Service,
Alaskan Region

The commissioning of seven NEXRAD radar sites in Alaska is a significant move towards providing real time weather to pilots. As flight service specialists have become familiar with the NEXRAD radar products, their requirements for specific radar products have evolved. As with any system there is a growth process involved and the Alaska Aviation Weather Briefing System (AAWBS) is no different.

The Memorandum of Agreement between the Department of Transportation Federal Aviation Administration and the National Oceanic and Atmospheric Administration National Weather Service, dated March 8, 1996, states in ARTICLE 1, *"The Alaska Aviation Weather Unit (AAWU) will continue to develop new products which will further assist the Flight Service Specialist in performing pilot weather briefings. FAA can also request additional products. The new or additional products will not require an amendment to this MOA. If the NWS determines that it can meet the FAA's request for additional products, both agencies will follow procedures in accordance with existing regulations and orders. All changes to the computer generated aviation graphics will be coordinated through the NWS Regional Aviation Meteorologist during normal duty hours.*"

In close coordination with the AAWU and the NWS Techniques Development Meteorologist, following is a list of NEXRAD products we now require. The products are listed in the order of priority with remarks appended reflecting the importance we attach to them as an aid to proper data interpretation.

1. ***0.5 Base Reflectivity*** - Provides information on the lowest level. It is included in every analysis.

2. ***VAD Winds*** - Provides wind information. It is useful in identifying shear zones, cloud layers and cloud tops. A great deal of information is available on this chart that can not be derived or verified on other charts.

3. ***Composite Reflectivity*** - Provides an overview and quickly identifies features or areas that warrant closer inspection. The COMBINED ATTRIBUTE TABLE is normally included on this chart. This table helps pinpoint storms (convective) and provides significant added detail. We are presently receiving this chart, but without the COMBINED ATTRIBUTE TABLE.

4. ***1.5 Base Reflectivity*** - Used in conjunction with the 0.5 Base Reflectivity. It helps identify areas of convective activity as well as areas of data contamination. It is also useful in identifying bright band returns (freezing levels and active icing zones), as well as differentiating between bright band and convective activity returns.

5. ***Echo Tops*** - Depicts the tops of areas of precipitation. It is very useful in areas of large thunderstorms, but not as useful here in Alaska. The VAD winds are a much better tool in our environment than the Echo Tops.

6. ***2.4 Base Reflectivity*** - Used in conjunction with the 0.5 and the 1.5 Base Reflectivity charts. Provides additional data which makes interpretation easier.

We are aware of system limitations that prevent VAD winds and range markers from being available in Alaska at the present. When they become available, we request they be provided to the flight service specialists. Our flight service specialist does not need the layered composite reflectivity charts (3 levels). The vast majority of weather is confined to the lowest layer and would therefore just repeat what is on the composite reflectivity chart.

We wish to maintain our continued close relationship between our agencies, if there are any questions or concerns, please call James (Kimo) Villar, at 907-271-5902

Willis C. Nelson

File:
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AAL-534:J Villar:VR:907-271-5902:3/2/99

# Weather Services in the Lynn Canal

A Study on the Feasibility of
Obtaining Additional Weather Reporting Capability Between
Juneau and Skagway, Alaska, with Additional
Commentary on Greater Southeast Alaska

Prepared by the
Federal Aviation Administration
Juneau Flight Standards District Office
Juneau, Alaska

May  1997

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Comments on this study may be directed to :


Federal Aviation Administration
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1873 Shell Simmons Drive, Juneau, AK 99801
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Phone: 800-478-2231 (Alaska only)

## Section 1. Background, Scope, & Purpose

Southeast Alaska is a land of challenge and opportunity. Traversing the full extent of the Alexander Archipelago, the region is a tapestry of fjords, woven through pristine wilderness, countless islands, and spectacular glaciers. In this magnificent setting the stunning works of nature dominate the mind.

This land is home to the forces which made her— both awesome and austere. As a fickle mistress her beauty shrouds a passion for perilous terrain and virulent weather. Enticing as a siren's call, her serenity can turn suddenly into strife.

In recent years, several of the aviation companies based in Southeast Alaska have requested improved weather reporting services for the area, specifically between Juneau, Alaska, and Skagway/Haines, Alaska. This area is known as the Lynn Canal. A study group was commissioned by the Juneau FSDO to investigate the issue and to make recommendations for possible solutions. This document is a report of their findings.

## Section 2. The Need for Additional Weather Services

The Lynn Canal is a narrow body of water, approximately 75 miles long and 7 miles wide. It is situated at the northern end of Southeast Alaska, stretching approximately north-south between Haines/Skagway, and Juneau, Alaska.

The canal lies about 70 miles inland from the coastline of the Pacific Ocean. There it forms the northern terminus of the famed "Inside Passage," which leads from Seattle to Skagway. The topography between the Lynn Canal and the Pacific Ocean is abruptly mountainous, with peaks reaching to 15,300' msl. This rise from tidewater to mountain top is the steepest coastal gradient in the world. Much of the area is capped by extensive glaciation. Appropriately, the region is home to such world famous attractions as Glacier Bay National Park. (See map.)

This part of Alaska is dominated by a westerly flow of relatively warm moist air, which sweeps in from the Pacific Ocean. As this onshore flow strikes the coastal range of the St. Elias Mountains, the air is lifted and cooled. This rising stream is further modified by contact with glacial ice.

These conditions produce generally unstable weather with extensive areas of precipitation. The islands and waterways of the region are bathed in seemingly continuous rain, drizzle, fog, or snow. The region is officially classified as a mid-latitude rain forest.

Juneau, at the southern end of the Lynn Canal, receives approximately 54 inches of precipitation annually, including 100 inches of snow. Moving away from the Lynn Canal the situation gets even worse. To the south, at Ketchikan, the precipitation averages 148 inches per year. Little Port Walter receives an average of 223 inches per year, and in 1987 received 292 inches. That same year, Yakutat, to the north of the Lynn Canal, was washed in 250 inches of precipitation.

Principal population centers along the Lynn Canal are Haines and Skagway to the north, and Juneau to the south. These cities are major tourist destinations. More than ten cruise ship lines provide regular summer service to these areas. The 1997 schedule calls for 371 dockings at Skagway alone. These ships will bring over 427,000 passengers to this tiny town.

These cruise ship passengers support a thriving industry in aerial sight-seeing and air shuttles. Thousands of flights are conducted each year carrying visitors to view the rugged mountainous terrain, the extensive coastal wilderness, and the spectacular glaciers.

There are no instrument approach facilities that service the Haines or Skagway airports. Accordingly, the vast majority of aviation operations along the Lynn Canal are conducted using small, single-engine, float and wheel equipped aircraft. These aircraft generally carry from three to nine passengers each, and operate exclusively under the Visual Flight Rules (VFR) provisions of FAR Part 135. These light aircraft require relatively good weather to reach their destinations and timely weather reporting is essential.

Unfortunately, weather along the Lynn Canal is typically poor. Due to the geographic situation and unique topography, the area suffers from a relentless influx of adverse conditions. The mechanics of lifting, cooling, and moisture reside in the area. These are major players in an ever-present drama of widespread precipitation, low ceilings, reduced visibilities, and torrential winds. Weather along the Lynn Canal can become violent, and change dramatically, in a matter of minutes. Aviation safety is inherently affected.

In the Lynn Canal, difficult weather is a fact of life. Each year, hundreds of flights must deviate due to deteriorating weather, or return to their origins without ever reaching their destinations. One commuter airline reported that in a typical year, at least two hundred of their flights are forced to turn back due to encounters with unforecast adverse weather. Many more flights are canceled altogether.

In the rapidly changing conditions it is not uncommon for light, VFR aircraft to become trapped along the Lynn Canal, with unforecast deteriorating weather both in front and behind. In 1989 this very situation resulted in the crash of a Piper PA-32, killing two persons and seriously injuring three.

Besides poor visibilities, the Lynn Canal is also famous for hurricane strength winds. In 1975, anemometers placed near Juneau by the Army Corps of

Engineers reported winds of 200 knots before the equipment was reduced to rubble. The windy “Taku” season extends from October to March. During that time the winds in the Juneau area frequently exceed 100 knots and these speeds have been sustained for periods of two weeks at a time. Meteorological conditions of this type pose a serious hazard to the operation of light aircraft, and even disrupt the service of commercial jets to the state’s capitol.

As home to these unique conditions, Juneau was selected for an ongoing study of low-level windshear detection using the new wind profiler technology produced by the Radian Corporation. This research is presently being conducted by the National Center for Atmospheric Research (NCAR), in conjunction with Alaska Airlines.

Compounding these traditional meteorological difficulties, in recent years Southeast Alaska has also been adversely affected by increasingly fewer weather reporting facilities. Up until the mid 1970’s the area enjoyed a considerable number of weather reporting stations that are no longer in service today. One air taxi owner stated, “Aviation weather services in Southeast Alaska are not nearly as good now as they were when I moved here in 1968.”

Prior to the 1970’s there were certified weather observers at Angoon, Tennake, Elfin Cove, Pelican, Hoonah, Sisters Island, and Kake. Additional support was obtained from Coast Guard observers at Cape Spencer, Five Finger Light, Eldred Rock, Sentinel Island, and Point Retreat. After the mid 1970’s, in accordance with the national move toward automation, four of these stations were reduced to basic machines; the rest were closed. With these closures, real time observations of the rapidly changing micro-climatic conditions ceased.

Given these special problems, in recent years the Lynn Canal has suffered from a tragically high incidence of aviation accidents. According to the National Transportation Safety Board (NTSB), since 1982 there have been fourteen, weather-related aircraft accidents in the Lynn Canal. This is an average of one per year. (See Appendix A.)

In addition to these, there are several other aircraft accidents that were not included in the NTSB report. In September 1996 a Piper PA-32 encountered fog in a mountain pass and crashed on a glacier at the north end of the Lynn Canal. In that FAR part 135 accident, one person was seriously injured.

Another unlisted accident involved the September 1987 crash of a Canadian operated Piper PA-31 Navajo near Eldred Rock. All five occupants were killed. The probable cause was VFR flight into instrument meteorological conditions. With these tragedies, the Lynn Canal death toll for weather-related aviation accidents (since 1982) now stands at 20 fatalities, and 11 serious injuries.

Southeast Alaska and the Lynn Canal in particular, play host to pristine isolation, severe weather, the extensive operation of VFR aircraft, and a dearth of alternatives. The area sports almost no roads and few suitable off airport landing sites. It is a land of precipitous terrain that plunges to icy waters. The operation of light aircraft in these conditions can be a challenging proposition.

In 1995, the National Aviation Weather Services Committee of the National Research Council conducted a study of the institutional issues that affect, (1) the provision of national aviation weather services, and (2) related research and technology development efforts. Their report, published by the National Academy Press, was entitled, "Aviation Weather Services, A Call for Federal Leadership and Action." In that report the writers have taken special note of the extraordinary needs of Alaskan aviation.

According to their report, "Some geographic regions of the Unites States have environmental conditions and user needs that vary significantly from national norms in the geographic density of weather observing sites, topography, availability of surface transportation, and other factors that accentuate the impact of adverse weather on aviation. Accurate forecasts are difficult to generate in areas where the density of observational data is very low or where complex topography generates localized, small-scale weather phenomena. ... In regions that have no surface transportation network, aviation may be the only practical source of food, fuel, and health services; and continuity of air service may be essential to normal life. ... Alaska, more than any other region of the United States, seems to have an aviation environment that illustrates how regional needs can differ from national norms."

The report continues, "Finding: VFR aviation in Alaska plays a role of uniquely vital economic and social significance. However, the safety and efficiency of aviation in Alaska is limited by deficiencies in the aviation weather system that have persisted for at least the last 15 years."

Nowhere is this weather problem demonstrated more clearly than in Southeast Alaska. The area has become a synonym for complex topography, hazardous weather, and the lack of real-time weather information.

Given these conditions, it is clear that some form of additional weather reporting for Southeast Alaska and the Lynn Canal would be of great benefit, both to the aviation community and the traveling public. Timely, accurate reports of the rapidly changing conditions would reduce the number of "look see" operations and aircraft turnarounds. More aircraft would safely reach their destinations more often. Improved weather reporting may even be able to reduce the number of weather-related aviation accidents that have pummeled the area.

An improvement in weather reporting capability for the Lynn Canal would be an investment in aviation safety and reliability. As seeds into soft earth, this investment can take root and produce a harvest of lives and property saved.

**Section 3. Suggested Sites for Weather Reporting Enhancement**

Echo Cove Bible Camp

Interviews with local aviation experts indicate that the worst weather in the Lynn Canal can usually be found in the vicinity of Berners Bay. Berners Bay is a narrow inlet, three miles wide and seven miles long. It juts from the eastern side of the Lynn Canal, approximately thirty miles north of Juneau.

At its eastern end, Berners Bay terminates in steeply rising terrain that leads to the heavily glaciated, upper reaches of the Juneau Ice Field. This majestic brute is a juggernaut of ancient glacial ice that sprawls over an area of 1,500 square miles. At its thickest point the ice is over 4,400 feet thick. If this ice were suddenly removed, it would leave a chasm deeper than the Grand Canyon.

As air is cooled by contact with this ice, it flows down-slope into Berners Bay, and soon mixes with the warmer, moist air of the Lynn Canal. This mixing often produces a river of fog that sweeps out into the canal, directly into the path of the many single-engine VFR aircraft and their precious cargo of tourists.

The south shore of Berners Bay intersects the Lynn Canal at Point Bridget. Two miles west of Point Bridget there is a Christian retreat known as the Echo Ranch Bible Camp. This camp is a 230 acre tract of land owned by the Gospel Missionary Union. The camp is situated two and a half miles beyond the end of the gravel road that terminates at Echo Cove. The camp is accessed by skiff, or by four wheel drive vehicles using the beach at low tide.

From the Echo Ranch Bible Camp there is a sweeping, unobstructed view of Berners Bay and its entrance to the Lynn Canal. This site is ideally situated to provide timely information on the weather in Berners Bay, which is considered the worst weather along the canal.

The camp director, Mr. Gary Lidholm, has been very receptive to the idea of placing weather equipment at the camp. A few years ago the Alaska Marine Highway established a small weather tower there. This tower has been supplying basic weather information in conjunction with an ongoing study for a proposed new ferry terminal. Mr. Lidholm reports that due to a lack of recent activity, he now considers the tower to be abandoned.

The Echo Ranch Bible Camp is presently supplied with electrical power by a 40 kw. generator. This generator operates year round, but only during daylight hours. Upgrade to a 70 kw. power plant is in the planning stage. Any permanent installation of weather reporting equipment at the camp could be powered by batteries which are recharged each day by the generator.

The Echo Ranch Bible Camp is perfectly suited to providing weather observations of Berners Bay and its entrance to the Lynn Canal. It has land availability and electrical power.  It would be a good site for the installation of weather reporting equipment.

<u>The Kensington Mine</u>

About nine miles north of Berners Bay is the Kensington Mine.  This site, previously known as the Comet Mine, is located in the vicinity of Sherman Point. This area is home to a developing gold mine.  This is a colossal enterprise that is ultimately expected to employ 300 people full time, for twelve years.

The Kensington Mine is a venture of Coeur Alaska, Inc., based in Juneau.  This company owns the mining claim and some of the actual property.  The rest of the land is leased from the U. S. government and administered by the U. S. Forest Service.  Once the necessary permits are received, the company plans a two year construction period.  Development is expected to begin in the Spring of 1997, and will include the construction of a permanent helipad.  The site can be serviced only by helicopter or barge.

When operations begin, the tailings from the mine will be deposited along a bluff, located approximately one-half mile from the shore of the Lynn Canal.  There they will be leveled and compacted.  At the completion of the project the tailings will form a raised rectangular pad, approximately 3,100 feet long (parallel to the Lynn Canal) and 1,800 feet wide.  It has been suggested that this feature might make an excellent runway, and that the site could ultimately be developed into an emergency airstrip.

From the beach in front of the existing maintenance hangar there is a commanding view of the Lynn Canal, both north and south.  The southern view includes the entrance to Berners Bay.  On a small bluff immediately behind the maintenance hangar the view is even better.  From there the entire central section of the Lynn Canal is exposed.  This would be an excellent location for the placement of permanent weather reporting equipment.

Power for the present operation is supplied by electrical generator.  When construction begins, this system will be expanded to include high output generators that will operate 24 hours a day.

The environmental coordinator for Coeur Alaska Inc. is Mr. Randy MacGillivray. Mr. MacGillivray has been very supportive of this study.  He is interested in bringing improved weather reporting services to the area.  He has shown a willingness to supply any assistance he can, including electrical power for weather equipment and assistance with site preparation.

The Kensington Mine will have a permanent helipad and may eventually evolve into an airport.  It has a superb view of the surrounding area.  It has electrical power and land availability. It would be an excellent location to provide enhanced weather reporting along the Lynn Canal.

Eldred Rock

Eldred Rock is a U. S. Coast Guard lighthouse located on an island in the middle of the Lynn Canal, approximately 22 miles south of Haines. Visibility from there is outstanding, providing a 360° sweep of the surrounding area. Access to the site is by helicopter or boat.

There are permanent structures located on the island, but the site is no longer manned by the Coast Guard. The traditional lighthouse operation has been replaced by an automated system. In the past, electrical power was provided by diesel generators that operated 24 hours a day. The generators are still in place and are in good condition, but they are no longer in operation. In conjunction with the U. S. Coast Guard's move toward automation, the lighthouse function has been shifted to solar power.

Commander Larry Voss is in charge of the Coast Guard facilities in Southeast Alaska. He has been helpful to this study and has offered any of the Coast Guard sites for the installation of additional weather reporting equipment.

Unfortunately, while the view from Eldred Rock very good, it also has a reputation for typically providing the best weather to be found anywhere along the Lynn Canal. One long time local aviator described Eldred Rock as, "A bubble of good weather." As a site for possible weather reporting enhancement, this would make Eldred Rock less desirable than a site more notoriously disagreeable, such as Berners Bay.

Greater Southeast Alaska, Industry Suggested Sites

Interviews with air taxi operators in greater Southeast Alaska produced a wide range of recommended sites for additional weather reporting. Most of the companies suggested sites that would best benefit their own areas of proprietary interests. There was very little consensus as to any single, most desirable site, outside of Lynn Canal. The following table lists their suggested locations.

| | | |
|---|---|---|
| Sites Suggested by Industry | | |
| | Name | Location |
| Additional Locations Within the Lynn Canal | | |
| 1. | Endicott River | Lynn Canal, 32 N of Juneau |
| 2. | North point of Ralston Island | Lynn Canal, 18 N of Juneau |
| 3. | Benjamin Island | Lynn Canal, 17 N of Juneau |
| Outside the Lynn Canal | | |
| 4. | Taku Inlet | 16 E of Juneau |
| 5. | Funter Bay | 12 SW of Juneau; N Admiralty Is. |
| 6. | Sisters Island VOR, in Icy Strait | 30 SW of Juneau |
| 7. | Elfin Cove | 55 SW of Juneau, at Pacific Ocean |
| 8. | Five Finger Island | 74 SE of Juneau, in Frederick Sound |
| 9. | Angoon | 39 N of Sitka; West Admiralty Is. |
| 10. | Klawock | 50 W of Ketchikan |

Many of these locations correspond with existing facilities operated by various agencies. These additional sites are considered below.

U. S. Coast Guard Sites

The U. S. Coast Guard maintains numerous marine aids to navigation throughout Southeast Alaska and they have offered access to these sites for the placement of weather reporting equipment. As with Eldred Rock, most of the Coast Guard sites have now been converted to solar power. Only two are still powered by diesel generator. Any equipment added to a solarized site will require additional solar components to generate the required electricity.

The components of a typical solar power installation include the panel array, a variable number of batteries, a solar aid controller, and associated electronics. The solar panel array is composed of approximately twenty panels. The exact number is determined by the site’s power requirements. Each panel is 14” wide and 24” high. Together they form an array that is usually about ten feet square and mounted at a 75 degree angle.

The solar panels do not power the site directly. Instead, they are used to charge the batteries. These batteries are six cell units that weigh about 600 lbs. each and deliver 12 volt electrical power. During the three darkest months of winter there is no effective power generation in Southeast Alaska. Accordingly, there must be enough batteries to power the site during that time.

The solar power installations in Southeast are remotely monitored by small microwave links which transmit telemetry data from each site. This data can be accessed, and adjustments made, by telephone. On-site servicing is minimal, and amounts to little more than adding water to the batteries once per quarter. Mr. Don Gutknecht in the Coast Guard engineering section reports that a complete, typical, low wattage solar power installation costs approximately $50,000.

Virtually all the Coast Guard sites still have installed generators, but with the move to solarization, the generators are sitting idle. These generators are rated at either 12 kw. or 6 kw. each, and provide 120 volt AC power. Each is supplied by an eight to ten thousand gallon storage tank for diesel fuel. These generators have been well maintained and typically have low hours on the diesel engines. All are considered to be in outstanding condition. The Coast Guard sites that are still powered by diesel generators are located at Guard Island and Five Finger Island.

The following table describes the Coast Guard sites in Southeast Alaska that may lend themselves to the placement of additional weather reporting equipment.

| U. S. Coast Guard Sites in Southeast Alaska | | |
|---|---|---|
| | Name | Location |
| Diesel Generator Powered | | |
| 1. | Five Finger Island | 38 NW of Petersburg - Stephens Psge. |
| 2. | Guard Island | 19 NW of Ketchikan |
| Solar Powered | | |
| 3. | Eldred Rock | 22 S of Haines, in Lynn Canal |
| 4. | Sentinel Island | 15 NW of Juneau, in Lynn Canal |
| 5. | Point Retreat | 12 NW of Juneau, in Lynn Canal |
| 6. | Cape Spencer | 70 W of Juneau, at the Pacific Ocean |
| 7. | Cape Decision | 75 SE of Sitka, at the Pacific Ocean |
| 8. | Mary Island | 20 SE of Ketchikan |
| 9. | Tree Point | 35 SE of Ketchikan |

Another aspect of these sites is the pending change to "outleasing." All of the Coast Guard sites are listed in the National Register of Historic Buildings. There is presently a plan underway which will make these sites available for lease to anyone wishing to establish a business. Several parties are already negotiating for various sites with plans to use the facilities as a retreat, hotel, or bed & breakfast. By the Spring of 1998 these sites are expected to be in full commercial operation. When this occurs, the electrical generators will once again be operating. Each site will then have lodging, transportation facilities, and generator power for much of the year.

## National Weather Service Sites

The National Weather Service (NWS) forecast office in Juneau is responsible for the collection and dissemination of weather data throughout Southeast Alaska. In support of their mission they maintain a number of automated weather facilities. These facilities include AWOS (Automated Weather Observing System) machines, and ASOS (Automated Surface Observation System). In Southeast Alaska there are twelve AWOS/ASOS sites, and six smaller supplemental stations.

The six NWS supplemental stations are solar powered and provide for the collection of only basic weather data such as air temperature, air pressure, wind direction, and wind speed. Data collected by these stations is relayed to the GOES satellite (Geo-stationary Orbiting Environmental Satellite), and from there to the National Weather Service. The following table lists the NWS facilities in Southeast Alaska.

| National Weather Service Sites in Southeast Alaska | | |
|---|---|---|
| | Name | Location |
| AWOS/ASOS Sites | | |
| 1. | Annette Island | 19 SE of Ketchikan |
| 2. | Gustavus | 36 W of Juneau |
| 3. | Hydaburg | 40 SW Ketchikan |
| 4. | Juneau | Juneau |
| 5. | Kake | 33 W of Petersburg |
| 6. | Ketchikan Intl. | Ketchikan |
| 7. | Klawock | 50 W of Ketchikan |
| 8. | Metlakatla | 14 SE of Ketchikan |
| 9. | Petersburg | Petersburg |
| 10. | Sitka | Sitka |
| 11. | Skagway | Skagway |
| 12. | Wrangell | Wrangell |

| Solar Powered Supplemental Stations | | |
| --- | --- | --- |
| 1. | Eldred Rock | 22 S of Haines, in Lynn Canal |
| 2. | Point Retreat | 12 NW of Juneau, in Lynn Canal |
| 3. | Point Bishop | 16 SE of Juneau, at Taku Inlet |
| 4. | Cape Spencer | 70 W of Juneau, at the Pacific Ocean |
| 5. | Cape Decision | 75 SE of Sitka, at the Pacific Ocean |
| 6. | Five Finger Island | 38 NW of Petersburg - Stephens Psge. |

Mr. Bob Kanan is a manager at the NWS Forecast Office in Juneau. He has indicated that any of their sites might be utilized for additional weather reporting equipment. All of their sites have available land, some form of access, a telecommunications system, and a power supply. Those sites that are powered by electrical generators have ample power available. Those sites that are solarized would need additional solar components to power any new equipment. Any of these sites would be ideally suited to receive additional weather surveillance equipment.

Alascom Sites

Alascom is a large provider of telecommunications services in Alaska. In support of their business they maintain microwave towers and other communications facilities throughout Southeast. Service technicians are transported to these sites primarily by helicopter. Many of these sites are fitted with video camera systems that are used for weather surveillance. Prior to any helicopter flight being dispatched to a site, the video camera is turned on and the actual weather at the site is ascertained. This real time information is used by the pilot in flight planning.

The cameras presently in use at the Alascom sites are of the “slow-scan” type. This technology is now considered to be somewhat outdated. These cameras are expensive and use the .gif video format. They produce images at a slow rate and with less than state of the art clarity.

Mr. John Hendricks at Alascom is now working on a project to convert all their sites to new technology .jpg format video cameras. These cameras produce photographs at a rapid rate and the images are of superior quality. Using high compression technology the photographs are rendered in 24 bit color, with 702 x 540 resolution. The Alascom cameras will not be moveable by remote control, but several cameras may be installed at the same site to provide different views.

Photographs from the .jpg cameras will be linked via VHF/UHF radios to a microwave station or satellite. From there they will be transferred to a centrally located computer server. The photographs will be disseminated to end users via the company’s intranet or wide area network (WAN). They will also be available by direct dial-up computer access.

The manufacturer currently suggests that this particular camera not be operated in temperatures less than 30° F. This is a recommendation only and is not expected to be limiting. In any case the cameras must be mounted inside a weather proof housing to protect from wind and rain. The new installations will use approximately 3 amps of 12 volt power and less than 40 watts. With these minimal power requirements these cameras lend themselves to solarization.

The Alascom sites are strategically scattered throughout Southeast Alaska. Four of them are within Lynn Canal. Some of the sites are located on hilltops at altitudes of about 2,000 feet. These sites provide excellent views of the surrounding terrain and weather. There are, however, a few days when these higher elevations are enveloped in clouds, while good VFR flying is still available below. The following table summarizes the Alascom sites.

Alascom Sites in Southeast Alaska

| | Name | Lat/Long | Location |
|---|---|---|---|
| With Presently Installed Video Cameras | | | |
| 1. | Rapinski Mtn. | 59°15'04" / 135°27'38" | 2 E of Haines, in Lynn Canal |
| 2. | Bessie Mtn. | 58°34'43" / 134°51'16" | 15 NW of Juneau, in Lynn Canal |
| 3. | Pt. Howard | 58°20'23" / 135°04'38" | 15 W of Juneau, in Lynn Canal |
| 4. | South Pass | 57°44'48" / 134°58'40" | 40 S of Juneau, at Tenakee |
| 5. | Manley | 57°06'54" / 134°48'38" | 18 E of Sitka |
| 6. | Gunnuk | 56°58'53" / 133°48'15" | 30 NW of Petersburg, at Kake |
| 7. | Duncan | 56°45'21" / 133°10'21" | 7 SW of Petersburg |
| 8. | Ratz Mtn. | 55°48'58" / 132°41'01" | 43 NW of Ketchikan |
| 9. | High Mtn. | 54°55'05" / 130°50'26" | 39 SE of Ketchikan |
| Sites Currently Without Cameras | | | |
| 10. | Sullivan River | 58°54'31" / 135°21'18" | 21 SE of Haines, in Lynn Canal |
| 11. | Cape Spencer | 58°11'58" / 136°38'18" | 70 W of Juneau, at the Pacific Ocean |
| 12. | Hoonah Mtn. | 58°06'30" / 135°26'30" | 30 SW of Juneau, at Hoonah |
| 13. | Wheeler Creek | 58°01'58" / 134°48'03" | 20 S of Juneau |
| 14. | Mud Bay | 57°09'10" / 135°38'37" | 12 NW of Sitka |

| | | | |
|---|---|---|---|
| 15. | Kashevarof | 56°14’09” / 132°58’38” | 35 SE of Petersburg |
| 16. | Meyers Chuck | 55°44’16” / 132°15’27” | 29 NW of Ketchikan |
| 17. | Tolstoi | 55° 37’ / 132° 23’ | 27 NW of Ketchikan |

Mr. Hendricks at Alascom advises that the company’s immediate strategy is to install the new .jpg cameras for their own use at High Mtn., Ratz Mtn., Mud Bay, Cape Spencer, and Tolstoi. Alascom is willing to make these real-time video photographs available to the public on a contract basis. Public access could be accomplished by establishing a new web site on the Internet. The images could then be accessed by anyone with a personal computer.

Alascom is also willing to install cameras at any of their other sites as selected by the FAA. Ms. Terri Smith at Alascom is the account executive responsible for contracts with the FAA. The Alascom sites are evenly dispersed throughout Southeast Alaska. Many are ideally situated for the installation of additional weather reporting equipment.

<u>Summary of Sites</u>

This study has introduced fifty-seven sites in Southeast Alaska that can be considered for weather reporting enhancement. These include three specific sites in the Lynn Canal, ten sites suggested by industry, nine sites operated by the Coast Guard, eighteen National Weather Service sites, and seventeen sites used by Alascom. Each of these locations must be evaluated with respect to land availability, access, electrical power, strategic location, and cost.

Most of the sites considered already have existing facilities and thus meet the requirements for land availability and access. About half of them are manned year round. Some are near native villages or small towns. These are accessible by road. The rest are accessible by helicopter or boat.

Approximately sixteen of the sites are powered by diesel generators. The majority of these are associated with village power supplies. Most of the rest are solarized. In any case, nearly all have existing power sources that can either be tapped or enhanced to provide electrical power for weather reporting equipment.

The question of strategic location concerns the desirability and usefulness of additional weather reporting at any particular site. The most beneficial sites will be those that are located near remote population centers, near areas of known problematic weather, or along busy, low-level aviation corridors.

The cost of developing a particular site must also be considered, especially as compared to the public benefit received. The cost-benefit ratio will be most advantageous at those sites that have good access, existing electrical power, and which serve a definitive need. This determination is further dependent upon the type of weather reporting equipment that is used.

## Section 4. Analysis of Alternative Weather Reporting Technologies

There are three existing technologies that could be applied to enhance weather reporting in Southeast Alaska and the Lynn Canal. These alternatives are certified SAWRS observers, AWOS/ASOS machines, and video camera surveillance systems. These three technologies are discussed below with regard to the timeliness, accuracy, and dissemination of their information, and their suitability to the present application.

SAWRS Observers

Historically, aviation weather observations were made by specially trained, ground based human observers. When new locations were needed, additional personnel were recruited and trained, and became part of the Supplemental Aviation Weather Reporting System (SAWRS). With the move toward automation in modern times, the use of human observers has been judged to be too costly. There are, however, still many SAWRS observation sites in operation, and these human observations have set the standards by which all new technologies are judged.

Timeliness of the SAWRS information is very good. Observations are taken hourly, or more frequently when warranted. The accuracy of these reports has become legendary. Instrument measurements are supplemented with visual observations and personal assessments. This system combines both objective and subjective elements. The marriage of these diverse methods produces a synergetic picture of local weather and developing trends.

The information gathered by SAWRS is disseminated on a proprietary computer network that is available to FAA Flight Service Stations, the NWS, and other government agencies. This system is also typically found in larger airline dispatch centers. In recent years the information contained in this network has been made available to anyone with a personal computer. Using special software, the system can now be accessed by dial-up modem or via the Internet, under a program known as DUATS (Direct User Access Terminal System).

A SAWRS observer stationed at a site in the Lynn Canal would provide an excellent service to the aviation community. An employee of the Kensington Mine or the Echo Ranch Bible Camp could be trained and equipped for this function. These positions are considered to be part time employment, and observers are paid only a few dollars per observation.

Unfortunately, even the minimal the cost of these labor intensive human services has now fallen into disfavor and is considered prohibitive. Most government agencies are terminating SAWRS contracts in favor of cheaper, automated electronic systems. The present plan for the FAA's Alaskan Region calls for the eventual discontinuance of those few contract weather observers (CWO) who are still operating. Details can be found in the FAA's Regional ASOS Implementation Plan for Alaska (Appendix C).

AWOS/ASOS Systems

In the late 1980s, both the FAA and the NWS sought the implementation of new technologies to replace manual weather observations with automated observing systems. In 1988 the FAA contracted for the manufacture of AWOS (Automated Weather Observing System), and in 1991 the NWS followed suit with procurement of an improved version called ASOS (Automated Surface Observation System).

One advantage of AWOS/ASOS over SAWRS is that their implementation has greatly increased the number of reporting stations. According to one official publication, "By the year 2000, the National Weather service, the FAA, and the Department of Defense, will have automated observations at 900 to 1700 airports across the United States. This will more than double the number of full-time surface aviation observation locations."

Timeliness of these weather observations is excellent. These machines take measurements every few seconds and average the results. Their official report is updated every minute, twenty-four hours a day.

Unfortunately, the accuracy of these reports has been disappointing to most end users. The "objective" instrument measurements have been satisfactory, but the machine does not provide any "subjective" visual observations or personal assessments. These machines are at a fixed location and sample the weather only at the station site. The machines are oblivious to weather conditions which may exist only a few miles away.

Quantitatively, these machines survey an area of only a few hundred square feet, but they look every few seconds, and average the readings. The SAWRS system, on the other hand, makes observations only once an hour, but the observer's visual assessments typically take in an area of more than one thousand square miles. This cognitive, subjective analysis, applied to a wide local area, is the missing element in the new automated systems.

Dissemination of the AWOS information is quite good. The data resides side by side with the SAWRS system and can be accessed in the same manner. Each automated station is additionally equipped with an electronically synthesized voice that continuously broadcasts that station's weather information. This report can be received by aircraft in flight using a VHF radio.

A principal benefit of the automated systems is cost. After the initial purchase and installation, these machines need only routine maintenance and thus very little additional funding. It is this cost savings that has been driving the recent move toward automation.

As previously shown, there are already twelve AWOS/ASOS systems installed and operating in Southeast Alaska. The Lynn Canal is served by stations at both Juneau and Skagway. A new ASOS will soon be established at Haines. The addition of another station at some point within the canal, such as the Echo Cove Bible Camp or the Kensington Mine, might prove to be very beneficial. However, since these machines survey such a limited area, another new station by itself might not satisfy the current need.

Video Camera Surveillance Systems

The use of permanently installed video cameras for weather surveillance is not a new idea. As previously seen, the concept has been implemented for years at Alascom, and also by the FAA at Potato Point in Valdez, Alaska. This technology is expanding rapidly throughout the world, and is also presently under study by the University of Utah.

In conjunction with the National Weather Service, the University of Utah provides access to twenty-two weather surveillance cameras around their state. These cameras are low-light models that produce high quality digital pictures in the .gif or .jpg video format. The photographs are stored on a computer server and made available through the Internet. The web site provides the current image and archived images for each location. Using an .mpg format, the photos can be arranged to portray a time lapse video of the area.

Photographs downloaded from the university web site to a personal computer can be enhanced with inexpensive image viewing software such as L-View Pro 1.6. Using this software these images have been able to reveal low-lying clouds, even when taken in total darkness.

Dr. John Horel is in charge of the university study. He reports that these cameras and their associated paraphernalia cost from two to five thousand dollars each. Photographs from these cameras can be seen at the university web site, www.met.utah.edu/html/cameras.html.

The Salt Lake City NWS Forecast Office is also very active in the development and implementation of weather cameras. They now operate approximately thirty cameras, installed at ten sites, with three cameras per site. Each camera utilizes a wide angle lens of 107°. As images are produced, they are stored locally on

IBM based personal computers. The images are automatically transferred to a centrally located computer server at fifteen minute intervals. One of their cameras is live on-line, and provides only a four second delay from camera to display. Their software also includes capability for time lapse replay.

The NWS cameras are sealed inside heated, weather proof housings. The units include provisions for windshield wipers. These cameras have successfully operated in temperatures ranging from well below zero, all the way up to 110° F. One of their sites uses a single camera and a motorized mounting. This mounting provides for pan, tilt, and zoom features.

Mr. Larry Burch is spearheading the camera project at the Salt Lake City NWS. He reports that initial installation costs have been averaging approximately $20,000 per site. This includes three cameras, heated housings, an on-site computer, and associated communications equipment. Reliability of these systems has been excellent. Recurring costs have been limited to the system-wide phone bill of approximately $2,000 per month. Some of these cameras can be seen at the Salt Lake City NWS web site, http://nimbo.wrh.noaa.gov/saltlake.

Another web site that utilizes a permanently installed video camera can be found at, www.okoboji.com. This camera provides a fixed view of Smith's Bay, at Lake Okoboji, Iowa. New photographs are taken every ten seconds in the .jpg format and are available in two sizes. There are also many other live video cameras located throughout the world. Some of them can be accessed on the Internet at, www.dreamscape.com/frankvad/cams-weather.html.

Another video camera effort is just now taking shape at National Weather Service Headquarters. They have selected twelve sites across the nation to participate in a demonstration program that will evaluate the use of weather cameras. One of the test sites selected is Valdez, Alaska. This installation is being managed by the Anchorage NWS office under the direction of Mr. Jim Kemper. Mr. Kemper reports that the Valdez project will utilize three fixed cameras, providing a 330° field of view. Images will be generated at one minute intervals and displayed to forecasters in the Anchorage NWS Forecast Office.

Video cameras conscripted to the weather surveillance mission provide some very attractive benefits. A typical camera view will encompass a very large area, providing information about weather that is well beyond the local area. These real-time video images can be used to compensate for the visual observations that are missing from the new, automated AWOS/ASOS systems.

Timeliness of these video observations is superlative. The new .jpg format cameras produce a high resolution color photograph in as little as ten seconds. The accuracy of these live photographs is self evident. They present the viewer with an exact representation of the real world, precisely as it exists at each moment.

To provide for different views a motorized mounting can be adopted which allows the camera to turn to several different directions, automatically updating specific views at successive intervals. Alternatively, two or more cameras can be installed at a given location with their views fixed to the most useful directions. The use of three cameras with wide angle lenses can supply a nearly 360° view of the surrounding area. This multiple camera approach also allows continued limited operation in the event one camera should fail.

Dissemination of this video information is handled by computer. The photographs can be posted to a server and made available on the Internet, or by direct dial modem. Once electronically stored, these pictures become part of a permanent record which can be accessed to reveal historical data or developing trends. The images can also be selectively arranged to provide a continuously updated, time-lapse view of weather conditions in the area.

Video photographs can also be presented live to FAA Flight Service Station personnel for use in weather briefings. A system of predetermined range and altitude marks can be developed for each site that would allow an objective analysis of ceiling and prevailing visibility.

Video cameras are ideally suited to provide the additional weather reporting desired for the Lynn Canal, and greater Southeast as well. This position is further supported by a 1993 study wherein the FAA recommended installation of three remote controlled video cameras that could be used for weather surveillance in the Juneau area. The suggested sites were Sisters Island VOR, Point Retreat, and Eldred Rock. This study can be found in Appendix B.

## Section 5. Conclusions

Over the years, the traditional human system utilized for weather observations has generated a venerable reputation for excellence. The genius of this system, what made it the incomparable standard that it is today, is that it combined two wholly different observational schemes. Its instrument measurements were tempered, modified, and augmented, by the real-life visual sightings of the human eye. This complementary redundancy established those reports with an element of common sense, which was validated by specially trained human interpretation and reliability.

With the present curtailment of existing weather observer contracts, it does not appear that establishing a new certified observer in the Lynn Canal would be in accord with current policy. On this basis, a SAWRS observer does not seem to be the best answer for the Lynn Canal.

Another option is the installation of an additional ASOS machine, but these devices are already established at both ends of the Lynn Canal, only seventy miles apart. These automated systems sample only a very small area, and do not provide the kind of information that is needed to detect rapidly changing micro-climatic conditions only a few miles away. Accordingly, it does not seem that another ASOS located somewhere within the Lynn Canal would solve the current problem.

The next option is the strategic installation of weather surveillance video cameras. After due consideration it appears that this technology offers the most promise for the enhancement of weather reporting in the Lynn Canal. These systems require very little space, have minimal power requirements, and an attractively low cost. Video photographs seem to present the most sensible solution with respect to timeliness, accuracy, dissemination of information, and applicability to the current need.

Many industry representatives agree. One aviation business owner from the local area stated that real-time video images of key points in the Lynn Canal would provide the best possible assistance to the dispatch of his company's flights. Especially, he added, if the pictures were made available to personal computers.

Video images provide real-time information on actual conditions. This information can be used in preflight planning, or relayed to enroute aircraft by ground personnel. If the cameras were co-located with existing ASOS equipment, their live photographs would provide an excellent visual complement to the ASOS instrument measurements.

The ultimate, futuristic weather reporting system for the United States, will be a virtual reality device that effectively transports end users to any selected location. Once there, a live video view from the site will surround the user in all directions. Human senses will be automatically enhanced by sophisticated electronic measurements. Readings will be projected on the surrounding view by heads-up display (HUD) or hologram. A time-lapse replay of recent data will be instantly available to reveal developing trends. Access to the system will be simple, continuous, and ubiquitous.

Video-augmented AWOS (VAWOS?) is a step toward implementation of this system. It will use presently available low cost technology to generate real-time video images. These photographs will allow for a subjective assessment which can be combined with the precision of the existing AWOS instrument measurements. With the change from human observers to machines, this subjective, visual element was lost. VAWOS can replace this essential, cognitive element, and produce a futuristic system that is better than anything known. Ultimately, video cameras might be installed at every ASOS site across the country, and included in all new ASOS acquisitions.

Video-augmented AWOS will produce a system of timely observations that will satisfy the hopes of the past.  Fresh AWOS instrument measurements and video camera visuals can be generated every minute, twenty-four hours a day.

The accuracy of this system will approach perfection.  Never before has any system hoped to effectively transport an end user to the actual site where weather information is desired.  Using real-time video images, the system will create a rudimentary type of virtual reality.  End users will be effectively placed on the ground at their selected locations, with their senses augmented by instrument measurements and instant replays.  Pilots will then be able to assess weather situations for themselves and evaluate their alternatives with respect to their own equipment and experience.

The dissemination of VAWOS information can be handled by personal computer. Real-time images and measurements can be accessed at home or at work, by the Internet or by FAX.  Enroute aircraft can be briefed on the changing conditions by company dispatchers or FAA Flight Service Personnel.

Ultimately, VAWOS data can be integrated into the emerging technologies of Safe Flight 2000.  Real-time photographs and weather reports can be uplinked directly to aircraft in flight.  These capabilities will eventually yield the ultimate advantage for mortals, in their ancient conflict with weather.  The result will be measured in lives saved, and a utopian efficiency of air commerce.

## Section 6. Recommendations

In response to requests from the aviation community, this study has analyzed the weather patterns of the Lynn Canal and greater Southeast Alaska. It has also considered numerous sites and three technologies for weather reporting enhancement in the area. Based on this analysis, a three phase plan has been developed as given below. These phases should be implemented sequentially, as funding will allow.

Phase I

1. Enter in to a contract relationship with Alascom to allow public access to their existing .jpg video images originating from High Mtn., Ratz Mtn., Mud Bay, Cape Spencer, and Tolstoi. This first step will establish a primary system at minimal expense.

2. To relieve weather reporting problems in the Lynn Canal, install an additional camera at the Echo Cove Bible Camp. A wide angle view should be utilized to take in the full extent of Berners Bay, including its junction with the canal. The equipment should be powered by a battery array that is recharged by the camp's generator. A contract arrangement for land and power should be established with the camp's owners. If the Echo Cove site should prove unfeasible, a similar arrangement should be sought at the Kensington Mine.

3. Dissemination of the photographs from these six sites should be accomplished by establishing a computer server and Internet web site that is available to the public. Software development should be coordinated with NWS and NCAR. Provisions should be made to allow presentation of both the current image, and also a continuously updated, time-lapse video that portrays the most recent three hour period. Associated ASOS information should be displayed on top of the photo, at the bottom of the screen.

4. Dedicated monitors for the videos should be installed at the Juneau Automated Flight Service Station, and the Juneau National Weather Service Forecast Office. Ceiling and visibility calibration points should be developed for each site. Briefers should attend a formal training course on the dissemination of this information.

Phase II

1. To provide additional video coverage near population centers and along heavily traveled aviation routes, add cameras at the following eighteen locations (in order of preference):

a. Alascom sites: Hoonah, South Pass (Tenakee), Manley, and Kashevarof.
b. Coast Guard sites: Cape Decision and Five Finger Island.
c. NWS rural sites: Pt. Bishop, Kake AWOS, Annette Island ASOS, Hydaburg AWOS, Klawock ASOS.
d. NWS city centers: Skagway ASOS, Juneau ASOS, Gustavus AWOS, Petersburg AWOS, Sitka ASOS, Wrangell AWOS, and Ketchikan ASOS.

2. Access to these sites has already been pledged by the respective agency. Electrical power will be provided by existing generators, or expansion of existing solar power collectors.

3. Addition of these sites will build a comprehensive network of weather information in a semi-virtual reality format. This will satisfy the hopes of the aviation community.

Phase III

Integrate the development of video-augmented AWOS with the emerging technologies of SAFE Flight 2000. This national study involves the development and early implementation of new products and procedures that will eventually enable “Free Flight.” The experiment is expected to generate a whole new paradigm for aviation management. From this foundation will emerge a comprehensive system of new technologies for national implementation. Among these technologies will be new parameters for weather reporting, including the continuous real-time exchange of weather information between aircraft in flight, and ground based facilities. Safe Flight 2000 has been tasked to provide an accelerated transition to the future.

The state of Alaska has already been designated as a national test site for Safe Flight 2000. Southeast Alaska can be recruited as a subset of this study. With its unique conditions and sequestered geography, Southeast Alaska could serve as a laboratory for the development of video-augmented AWOS. Installing video systems at the twenty-four sites suggested herein would enable the generation, testing, and refinement of new hardware and software. These products can be integrated into Safe Flight 2000 to build a futuristic weather reporting system for the next century.

## Section 7. Study Summary

### Summary of Section 1: Background, Scope, & Purpose

a. This study was undertaken by the Juneau Flight Standards District Office of the Federal Aviation Administration, with a mandate to investigate the feasibility of obtaining additional weather reporting services in the Lynn Canal.

b. The study was initiated at the request of the aviation industry based in Southeast Alaska.

### Summary of Section 2: The Need for Additional Weather Services

a. The Lynn Canal is a narrow waterway that stretches between Juneau, Alaska, and Haines/Skagway, Alaska.

b. Due to its unique situation and topography, the area is classified as a mid-latitude rain forest and is subject to a prevailing pattern of inclement weather.

c. The area includes several major tourist destinations.

d. Most flight operations in the area are conducted using light, single-engine aircraft operating under Visual Flight Rules.

e. These aircraft routinely fly in an environment of reduced visibilities, low ceilings, and blustering winds.

f. Since the mid 1970s the area has suffered a decline in aviation weather reporting services.

g. Since 1982 there have been at least sixteen weather-related aviation accidents in the area. These accidents have resulted in the tragic loss of life and property.

h. Some form of additional aviation weather reporting is highly desirable.

i. This need is further substantiated by an FAA recommendation made in 1993, and by a National Research Council study conducted in 1995.

**Summary of Section 3: Suggested Sites for Weather Enhancement**

a. The worst weather in the Lynn Canal is typically encountered at Berners Bay.

b. Echo Cove Bible Camp is ideally situated to provide a sweeping observation of Berners Bay. The camp directors are willing to support an installation of weather surveillance equipment.

c. The Kensington Mine is also well suited to provide an observation of Berners Bay. The owners of the mine have indicated a willingness to provide substantial support for the installation of weather equipment.

d. Eldred Rock is a U. S. Coast Guard lighthouse located on a small island in the northern portion of the Lynn Canal. This site provides a 360° view of the canal and would be ideal for weather reporting enhancement. The NWS already maintains a rudimentary weather station there. This site is not considered as strategically located as the previous sites, because the area typically has the best weather to be found along the canal.

e. The aviation users in greater Southeast Alaska have recommended ten sites for weather reporting enhancement. Their fervor bears testimony to the need for additional services in the area. Many of the suggested locations have existing facilities operated by various agencies.

f. The U. S. Coast Guard operates nine facilities in SE Alaska that may lend themselves to the installation of weather reporting equipment. The Coast Guard has offered access to their sites as well as technical assistance. Two of their sites are powered by electrical generators; the rest are solarized. With the move toward "outleasing," by the Spring of 1998, many of the Coast Guard sites will have generator power available.

g. The National Weather Service operates twelve ASOS sites and six supplemental weather stations in SE Alaska. Most of these sites are powered by electrical generators; the rest are solarized. All of these sites are available for possible weather reporting enhancement.

h. Alascom operates seventeen remote communications facilities throughout SE Alaska. Five of them will soon be equipped with new .jpg format video cameras which are used for weather surveillance. Alascom has indicated that the photographs from these sites could be made available to the public on a contract basis. Access could be provided via the Internet. Alascom is also willing to contract for the placement of additional weather cameras and supporting equipment as required.

i. This study has considered fifty-seven sites for weather reporting enhancement. Each of these must be evaluated with respect to land availability, access, electrical power, strategic location, cost, and the type of weather reporting equipment desired.

**Summary of Section 4: Analysis of Alternative Weather Reporting Technologies**

a. There are three existing technologies that can be applied to enhance weather reporting in the Lynn Canal and greater Southeast Alaska. These alternatives are SAWRS observers, AWOS/ASOS machines, and video camera surveillance systems. Each of these systems must be evaluated with regard to the timeliness, accuracy, and dissemination of their information, and their suitability to the present application.

b. The SAWRS system utilizes human observers and supplements instrument measurements with subjective, visual observations. This system produces a high quality report, but is now considered to be too expensive. Human contract weather observers are now being phased out in accord with a national move toward automation.

c. The AWOS/ASOS system of automated weather observing equipment is considered cheaper and thus more desirable than the older, labor intensive system. The proliferation of ASOS has increased the number of observation sites throughout the country, as well as the frequency of observations. Unfortunately, these systems provide only instrument measurements; they do not provide any visual, subjective observations. These machines survey only their immediate area, and are unaware of weather conditions that may be developing only a few miles away. Many end users are dissatisfied with the quality of these new automated reports.

d. The use of video cameras for weather surveillance is an idea that has been in use for several years, and is enjoying widespread acceptance. The timeliness and accuracy of real-time video photographs is self-evident. Dissemination of the images can be handled by computer, with access provided via the Internet or by direct dial modem. These systems are relatively inexpensive to install and maintain. Live video cameras are an automated system that would satisfy the current need for improved weather reporting in SE Alaska.

**Summary of Section 5: Conclusions**

a. The implementation of a new SAWRS observer in the Lynn Canal does not seem to be in accord with the present move toward automation.

b. The addition of a new ASOS site in the Lynn Canal would probably not solve the problem of ascertaining the weather at Berners Bay.

c. The use of video weather cameras seems to satisfy the cost-benefit equation and to serve the public need.

d. The marriage of video with ASOS would provide the visual observations that are missing from the new, automated observing systems.

e. Ultimately, video cameras might be installed at every ASOS site in the nation. This combination of video with ASOS might prove to be a major step toward a virtual reality weather reporting system of the future.

f. Evolution of this synergetic combination should be merged with the developing technologies of Safe Flight 2000.

**Summary of Section 6: Recommendations**

a. In response to customer requirements, this study has generated a three phase plan for the implementation of video weather cameras in SE Alaska.

b. Phase I. Establish a primary system utilizing the five .jpg cameras at Alascom. Install a sixth camera at the Echo Cove Bible Camp. Make the video images available on the Internet. Develop the software required to present both a current image and a continuously updated time lapse view of each site. Install dedicated monitors at the Juneau AFSS and Juneau NWS, and provide formal training for briefers.

c. Phase II. Expand the video surveillance network by adding cameras at eighteen additional sites.

d. Phase III. Designate SE Alaska as a national test site, and integrate the development of video-augmented AWOS with the emerging technologies of Safe Flight 2000.

# Appendix A

**NTSB Accident Summary for the Lynn Canal, 1982 to Present.**

# Appendix B

**Copy of Previous Weather Enhancement Study for the Juneau Area. Alaska FY'95 Project Action Request.**

# Appendix C

## Copy of FAA Regional ASOS Implementation Plan for Alaska

# Appendix D

## Index of Technical Personnel

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Qualimetrics
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Vaisala Corporation
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Handar Corporation
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**Juneau Turbulence Project**
**Trip Report**
**Anchorage and Juneau, Alaska**

April 20-22, 1999

On April 20th, the AWRP team visited Alaska Regional office to meet with regional personnel to discuss issues relating to the Juneau Turbulence project.

Dave Sankey, the Product Lead for Aviation Weather Research and Weather Sensors Programs opened the meeting, followed by statement of goals by Steve Albersheim. Alfred Moosakhanian presented a status briefing on the Juneau effort, outlining the three phase implementation approach. Bob Barron of NCAR then presented a briefing on the Phase 1 system description. Tom Carty, ACT-320 made two presentations, the first on Juneau Turbulence User Need Summary and the second on the status of anemometer survivability test at Mt. Washington, New Hampshire Test site. Copies of all presentations were provided at the meeting.

The meeting was opened for discussions and open issues following the presentations. The following are some of the major issues and actions that came up in the afternoon session.

**General:**

1. It was indicated that this effort was mandated through Congressional language via Senator Ted Stevens. This activity is to be completed within a short period of time.

> **ACTION: AUA-430 to review the Congressional language and determine exactly what was to be performed during this FY and if we had achieved the Congressional expectations through the purchase of the anemometers.**

2. Agreement was reached that placing the 3 anemometers into the NAS during FY99 was not feasible.

> **ACTION: AUA-430, AND-420, and Regional personnel to tailor the In-Service Review Checklist (ISR) to fit this project. It would then be documented into a program plan. The ISR checklist was issued at the meeting and work has begun.**

**Budget:**

Agreement reached during the meeting was to acknowledge the fact that we are working with 3-year money and the earliest that F&E and O&M could get funding would be in FY01. It was agreed to work toward placing into the FY01 budget for O&M at the Regional level a cost estimate for operating and maintaining this "one of a kind" system located at Juneau, Alaska. It became apparent that F&E would not play into this budget structure and would be working from the planned RE&D funding. In other words, the "up front" (non-recurring costs) installation, maintenance, and operational costs which are normally part of the acquisition costs would now be borne by RE&D funding. However, research and analysis would still be performed on this unique system.

**ACTION: Alaska Region to request O&M budget for FY 01.**

**Certification:**

1. The certification issues were discussed both from the Air Traffic Services and from Airway Facilities points of view. It was determined that with the purchase of the anemometers in February of 1999, the data being used was not certified. The question of FAA legal liability arose if an accident would occur since we now own the system. Regional Air Traffic group pointed out that there is no operational requirements document created for this project. This document is essential and is used by Air Traffic to determine the certification of the system for operational use in the NAS. It provides the baseline to determine if all operational requirements are met for a particular system; thus giving it credibility into the NAS and defining the products obtained from that particular system. AT certification occurs both for equipment and also the training of the AT controllers.

**ACTION: AUA-430 with the assistance of Air Traffic and Flight Standards will prepare the operational concept and its requirements for the anemometers and wind profilers.**

2. Airway Facilities expressed a similar concern. Again system and people certification is necessary. Baseline documentation for system certification for maintenance personnel is based on the technical performance and maintenance documentation, which is annotated in the Facility Reference Data File. Such technical documentation should include instruction books, maintenance technical data, schematics, test reports and data, periodic maintenance instructions and a Maintenance Handbook usually produced within the AOS community, which summarizes much of the essential technical information.

**ACTION: Request to NCAR as to the availability of technical documentation and to be provided with the information.**

**ACTION: AF to compile a list and determine the necessary documentation that is required to support the system.**

3. Methods of using the data without full FAA certification centered on the National Weather Service and making the information available through them.

**ACTION: Regional AT personnel to investigate NWS data distribution path.**

**Commissioning of the System:**

Discussion evolved around whether the system (anemometers and profilers) would be a regular operational or an advisory system. The essentiality of the system became a question. The overall initial costs of a project centers on this determination. For example the amount of spares to be procured is far less for an advisory system than a regular operational system. It also figures into the ability to commission a system. Commissioning a system is merely the formal exercise of incorporating a new system into the NAS. The ultimate determination that the system will be commissioned for service is dependent upon the technical performance of the equipment and the attainment of the requirements for operational service (operational requirements document).

ACTION: AUA-430 to develop a test NCP for the anemometers and profilers. This NCP is to request authorization of the continued use of this nonstandard piece of equipment in order to continue testing, acquiring data, and analyzing it. This effort to be coordinated with the Region for concurrence.

**Y2K Compliant:**

NCAR was asked if the equipment was Y2K compliant.

**ACTION: NCAR to respond to this question.**

**Frequency Authorization:**

NCAR was asked if the frequency was transferable to the FAA.

**ACTION: NCAR to respond to the frequency transfer question.**

On April 21-22, the team traveled to Juneau and toured the equipment sites and facilities. In Juneau the team further discussed the above issues and actions with Juneau AFSS, Tower and NWS personnel.

**Facility Alpha and Identification Codes:**

While in Juneau AND-420 discussed the facility Alpha and Identification codes with AF personnel. The assignment of this code is necessary in order to validate that the system is part of the NAS. It also affects the use of common pieces of test and repair items available through the ISSAC's (FAALC specific). However, there is some question as to the need for this code for this system. Needs to be investigated.

**Schedule of events and actions:**

See attached Microsoft Project file.

**Anchorage Meeting Attendees:**

| NAME | ORG. | PHONE |
|---|---|---|
| Dave Sankey | AUA-430 | 202-366-8985 |
| John Madden | AAL-4 | 907-271-5177 |
| Bob Barron | NCAR/RAP | 303-497-8410 |
| Al Yates | NCAR/RAP | 303-497-8451 |
| Trent Cummings | AAL-501 | 907-271-5464 |
| Kimo Villar | AAL-534 | 907-271-5902 |
| Mike Presley | AAL-512.3/NISC | 907-271-2882 |
| Jack Schommer | AAL-532 | 907-271-5903 |
| Karla Walz | SA SMO /AF | 907-269-1191 |
| Jack McAllister | SA SMO /AF | 907-269-1278 |
| John W. Smith | AAL-470 | 907-271-2361 |
| Larry Ihlen | AAL-470 | 907-271-5832 |
| Cynthia Schauland | AND-420 | 202-267-9439 |
| Tom Carty | ACT-320 | 609-485-4033 |
| Ray L. Anderson | AAL-572 RA | 907-271-4079 |
| Carl N. Gleason | AAL-512.5/NISC | 907-271-5884 |
| Dave Palmer | AAL-512 | 907-271-5352 |
| Steve Albersheim | AUA-430 | 202-366-0127 |
| Alfred Moosakhanian | AUA-430 | 202-493-0043 |

**Juneau Meeting Attendees:**

| NAME | ORG. | PHONE |
|---|---|---|
| Carol Veazie | JNU AFSS | 907-789-6124 |
| Linda Lang | JNU AFSS | 907-789-6125 |
| Steve Turner | JNU ATCT | 907-789-7459 |
| Jim Kemper | NWS | 907-271-5131 |
| Duane H. Msewen | FAA JNC SSC | 907-789-2193 |

| | | |
|---|---|---|
| William A. Alexander | NOAA/NWS | 907-271-5132 |
| Carl Diering | NOAA/NWS | 907-790-6806 |
| Leif Lei | NOAA/NWS | 907-790-6804 |
| Bob Barron | NCAR/RAP | 303-497-8410 |
| Al Yates | NCAR/RAP | 303-497-8451 |
| Mike Presley | AAL-512.3/NISC | 907-271-2882 |
| Jack Schommer | AAL-532 | 907-271-5903 |
| Ray L. Anderson | AAL-572 RA | 907-271-4079 |
| Steve Albersheim | AUA-430 | 202-366-0127 |
| Alfred Moosakhanian | AUA-430 | 202-493-0043 |